OFFICIAL PUBLICATION OF THE PROCEEDINGS AMERICAN ASSOCIATION OF TEXTILE CHEMISTS AND COLORISTS

JANUARY 23, 1950
VOLUME 39, NO. 2

AMERICAN DYESTUFF REPORTER

DEVOTED TO TEXTILE CHEMISTRY • BLEACHING • DYEING • PRINTING • FINISHING

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How wool mills chop costs

Mill management is being called on to deliver profits even when sales volume is down. One plain way to do it is to pare operating costs, to produce less expensively and in less time. Many mill managers, and more every day, are realizing they can do this with a Monsanto chemical, Syton, because Syton gives from 10%-to-30% more yarn strength in woolen and worsted spinning.

Here is how Syton increases earnings:

1. By helping to produce more in less time.

Many mills ... spinning carpet or knitting yarns for example...reduce twist with Syton and hence boost production. Other mills report fewer ends down during spinning and weaving ... better roping condensation, reduced fly and card waste. Production costs go down, savings up.

Hundreds of woolen and worsted spinners...more every day...are proving that Syton is a practical production speeder...and a money maker for management.

Certainly that's reason enough to find out how Syton can work in your own mill. We're ready to give you full details about Syton and our technicians are ready to help you right at your own plant.

New, free booklets describe your savings with Syton

For woolen spinners: *"Syton for stronger, more uniform yarns."*
For worsted spinners: *"Syton for worsted spinning: More uniform yarns, increased strength, yarns spun closer to count."*
For carpet makers: *"Syton for loftier, 'more blooming' yarns."*
For Commission spinners: *"Syton for faster spinning of all types of fibers."*

2. By improving the product

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Booklets available through handy coupon on right-hand page.

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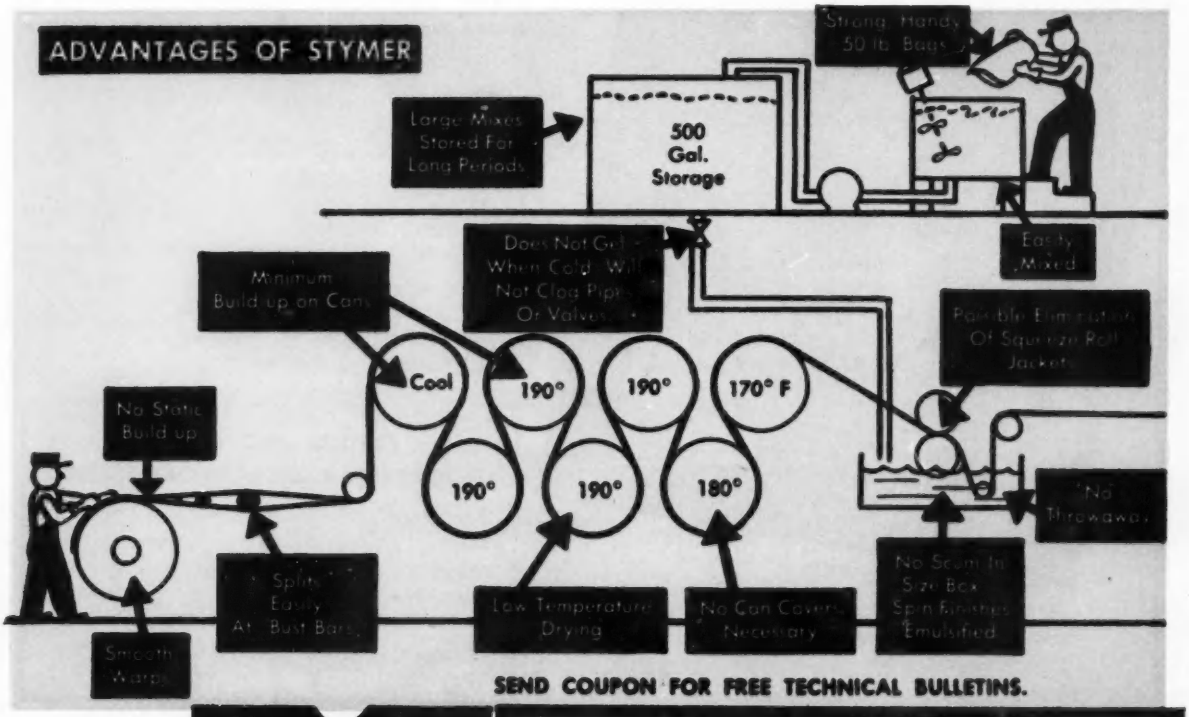

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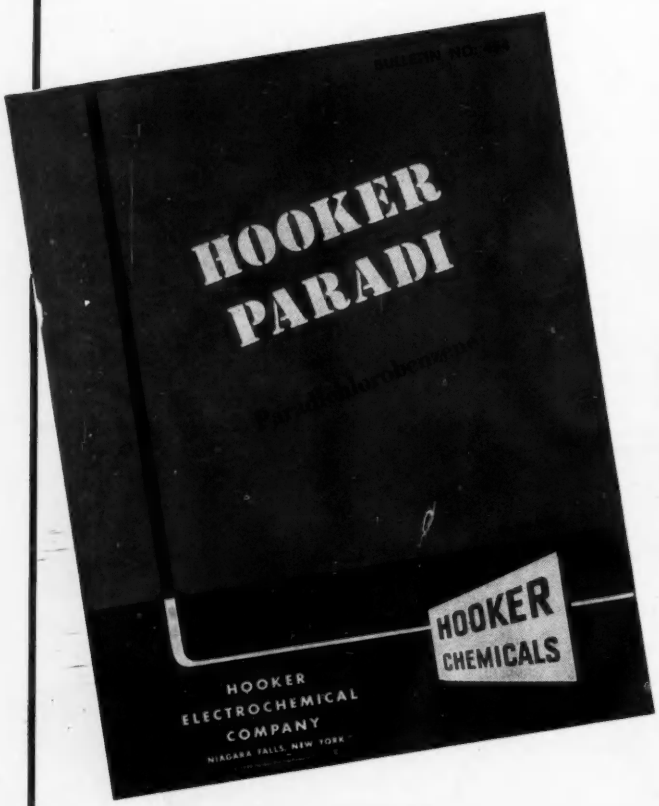

HOOKER's new Bulletin No. 454 on Paradichlorobenzene can be your guide to increased sales and profits if you are interested in the fumigant, deodorant and disinfectant markets. It describes the many uses and application of paradichlorobenzene, methods for reforming and repackaging—contains a table and illustrations of exact screen sizes—just the information a repackager or specialty manufacturer needs.

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Form	Crystals in 7 sizes
Melting Point	53°C
Boiling Point	173°C
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Shipping Containers	25, 50, 100, 200 lb. Fibre Drums

A request on your company letterhead will bring this bulletin to you promptly. Chemists who are interested in other physical and chemical properties should ask for Technical Data Sheet 749.

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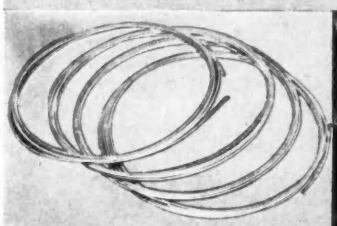

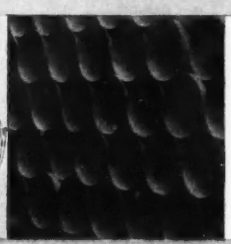

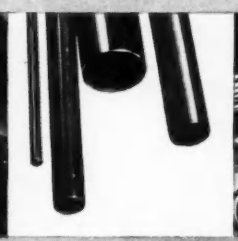

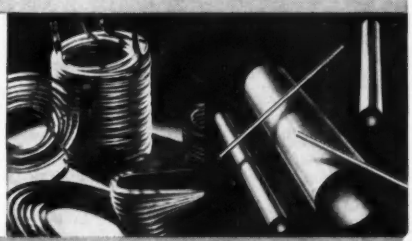

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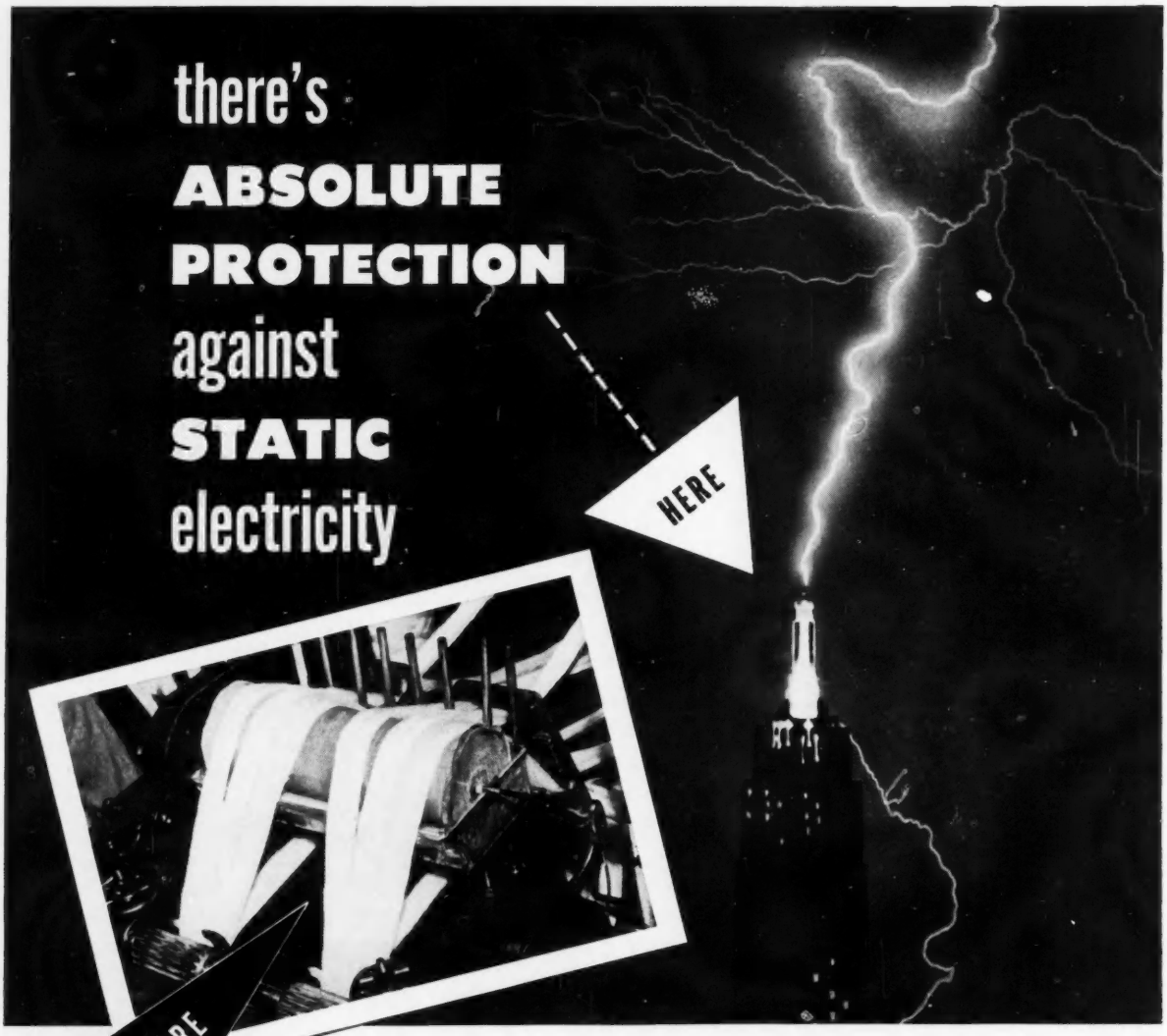

Today's architects and builders have the means to protect their creations from electricity on the rampage . . .

. . . and today's WORSTED manufacturers have the means to protect the quality of their products from mischievous electricity—STATIC that plays havoc with desirable yarn production. For Nopco's new, specifically developed lubricant —NOPCO* 1656-R—provides an anti-static oil that assures better WORSTED production.

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You get sunbright color and razor sharp detail. **AMBERTEX M** is a widely accepted vat thickener for textile printing . . . with penetrating qualities that insure complete discharge of the ground color . . . and cohesive properties that hold the line to the exact proportions of the original engraving.

Photo courtesy of TEXTRON

AMBERTEX M minimizes splitting on French Crepes and Bemberg sheers. It deposits a soft, pliable film on the cloth. Prints no longer embrittle, crack or rupture – as they do with ordinary thickeners.

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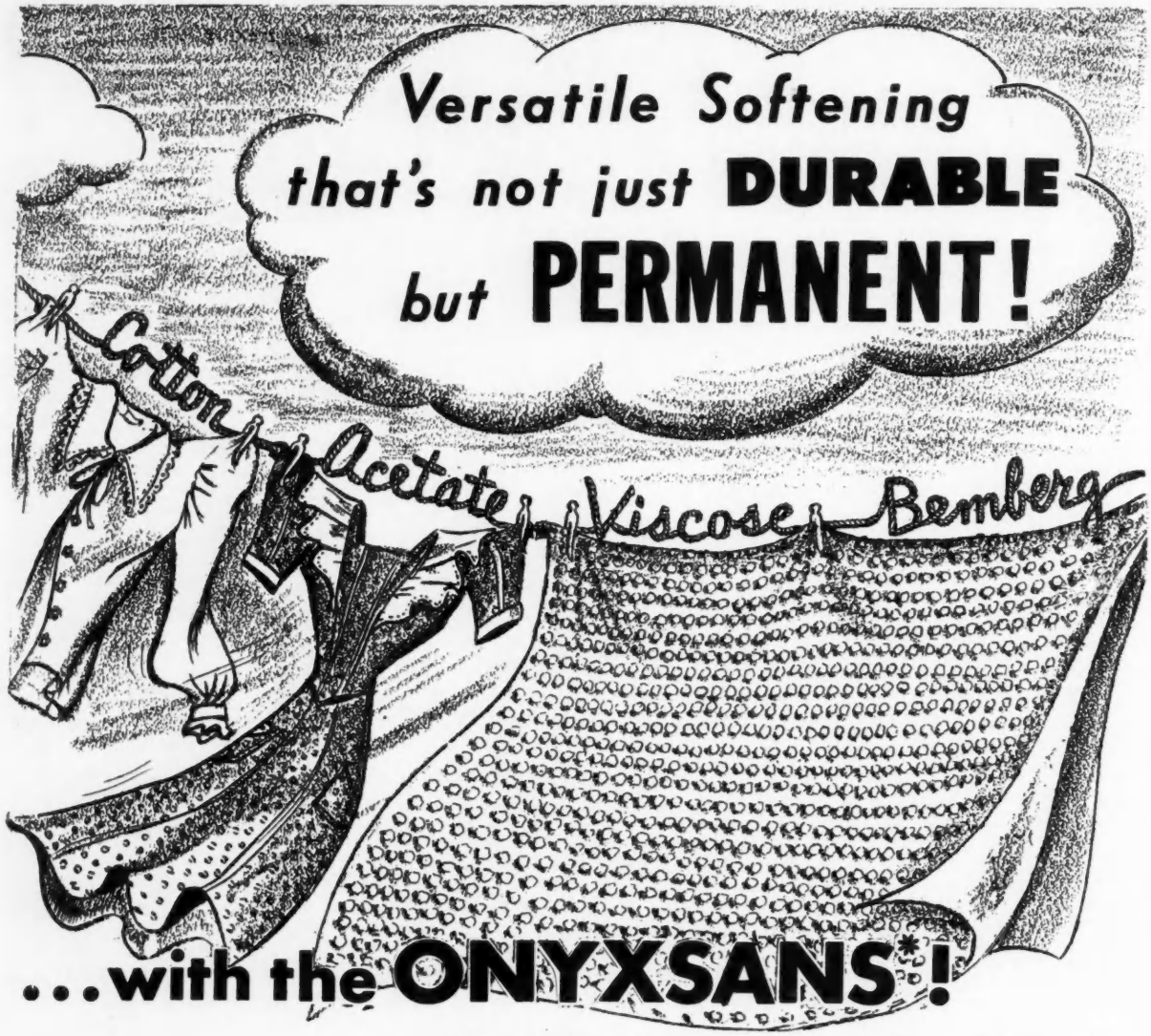

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JANUARY 23, 1950
VOLUME 39 NUMBER 2

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Auxiliaries and Testing Group—

EVALUATION OF WETTING AGENTS*

LEONARD SHAPIRO

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1. SINKING TIME TESTS EMPLOYING WOVEN TAPES

OF the many methods proposed for evaluation of textile wetting agents, none is so universally employed as the "Draves Test" (A.A.T.C.C. Standard 17-43) *(1)*. The reasons for the wide acceptance of this test obviously lie in the simplicity and ready reproducibility of the method, as well as the fact that no special equipment is required.

It has occurred to several investigators that the test method could be made a bit more convenient if woven tapes or cloth strips were substituted for skeins. *(2, 3)*. Since most dyers and finishers employ wetting agents on fabrics, rather than on skeins, they would feel more confident in interpreting wetting test results in terms of their plant processing if such tests were performed on woven fabrics. As early as 1937 Ciba Company was reported to have developed a modification of the Draves Test employing tapes *(2)*, and other workers have undoubtedly worked out similar techniques despite the fact that no published literature has appeared on the subject.

The object of this investigation has been to develop a simple wetting test employing woven tapes and to correlate the results with the standard skein tests.

For this purpose, a 9-inch length of 1¼ inch binding tape, natural† (E. L. Mansure Co., Philadelphia) was selected. This is about the same length as the skein employed in the Draves test, but since it is much lighter (1.75 to 1.95 gms.) a proportionately lighter hook must be employed. Preliminary tests were carried out with a 1.25-gram hook, but later investigations showed that a 1.00-gram hook gave sinking times approximating those obtained with 5-gram skeins (and 3-gram hook) and that lighter hook weights are preferable for greater wetting-out at the moment sinking occurs.

* Presented at the Auxiliaries and Testing Group Meeting, Atlantic City Convention, October 14, 1949.

† Standard tapes, hooks and anchors are supplied by U. S. Testing Co., Hoboken, N. J.

Advantages of Tape Test Method

The tape test was found to have the following advantages over the skein method:

(a) *Greater speed and ease of handling.* The need for reeling off 5-gram skeins is eliminated.

(b) *Greater accuracy with a smaller number of duplicate tests and less "freak readings".* This is undoubtedly due to the much smaller and more uniform size of the air bubbles entrapped by woven fabrics. (In one series of tests, it was found that two tape tests were adequate to give accuracy within 5%, while 13 skein tests were required for the same accuracy).

(c) *Less solution is removed by the tape* than by a skein, and many more tests may be run on the same liquor without loss in volume or exhaustion of surface active agent.

(d) *Use of woven material makes interpretation simpler* and allows direct correlation on the same fabric with surface-drop tests employing 1-inch squares or circles, rewetting tests, etc.

(e) *Wetting and rewetting tests may be run on the same fabric* by the same technique.

Description of Test Method

Equipment: Stopwatch

500 ml. graduate—distance from 0 to 500 ml. mark = 12" ± ¼ (305 ± 5 mm.).

Anchor: 40 gm. lead weight, 1-inch diameter.

Hook: 1.00-gram hook, 1 inch in length (other hook weights are employed as required). Hook end filed to shart point.

Distance from anchor to hook: 20 mm. (tied with nylon thread).

Tape: Standard 1¼ inch binding tape, natural† (E. L. Mansure & Co.). Each batch of tape is checked with a standard sample of wetting agent before use.

Length: 9 inches (228 mm.).
Width: 1¼ inches (31.5 mm.)
Weight of 9 inches: 1.85 ± 0.10 gms.

(Note: Laboratory graduates vary in length, and it is well to set aside a few within the above specification for use in wetting tests. A flat or slightly concave bottom is better than a convex bottom which causes the anchor to tip over or slide to the side of the cylinder. For wetting tests at temperatures exceeding 75°C., Pyrex graduates will be found best).

Procedure: (1) The required amount of surface-active agent is dissolved in 100 ml. to 200 ml. water at 80°C. and is diluted with water to 1 liter. Hardness, electrolyte concentration or pH are adjusted as required. For test temperatures greater than room temperature, the solution is heated slightly above the temperature required.

(2) The solution is transferred to the 500 ml. graduate, and the temperature is finally adjusted within 1°C. of the required value.

(3) The hook is inserted through the tape, about ¼ inch from one end on the center line.

(4) The tape is held by the free end so that the anchor and bottom of the hook are just submerged in the liquid in the graduate.

(5) The tape is dropped, and the stopwatch is started at the sound of the anchor striking the bottom of the cylinder.

(6) When the hook and tape start to sink at a constant rate, the "sinking-time" its reached and the watch is stopped.

(7) Repeat tests are run until the required degree of precision is attained (2 or 3 tests are generally adequate).

(8) Results are tabulated or plotted on log-log paper.

In tests *D* and *E*, a fresh 500 ml. portion of solution was used for every five tests. In test *A*, 12 tests were run on one portion of solution and the last six tests were run on a fresh portion of the same solution. By contrast, the 22 tape tests of test *B* were all run on the same 500 ml. portion of solution without appreciable

TABLE I
Reproducibility of Tape vs. Skein Sinking Tests and 1-inch Square Tests

	Tergitol 7 at 25°C.			*Syntholite #170 at 25°C.*		
	A Skeins	*B Tape*	*C 1-Inch Squares*	*D Skeins*	*E Tape*	*F 1-Inch Squares*
Hook Weight	3.00 gm.	1.00 gm.		3.00 gm.	1.27 gm.	
Concentration	*0.75 g/l.*	*0.75 g/l.*	*1 gm/l.*	*1.0 g/l.*	*0.5 g/l.*	*1 gm./l.*
	20	16	55	16.2	17.0	38
	18	17	56	22.5	17.0	32
	17	16	56	16.0	16.8	35
	17	16	58	16.5	15.8	35
	17	17	54	16.5	16.5	33
	20	16	51	18.0	15.0	37
	21	16	47	15.0	16.0	34
	20	16	47	19.0	17.5	33
	18	16.5	50	17.5	16.2	35
	19	17	52	13.0	16.0	33
	22	16.5	49	15.2	16.5	36
	22.5	17	46	15.5	16.0	40
	17	16	47	16.0	15.5	35
	18	17	65	17.2	16.5	34
	28	16.5	70	17.5	16.8	33
	17	18	58	16.2	16.5	32
	25	17	46	16.5	16.0	34
	20	18	50	16.0	15.0	37
		16	50	15.2	15.5	35
		17	56	16.2	15.5	34
		17.5				
		16.5				
Mean	19.8	16.66	53.1	16.58	16.16	34.7
Std. Devn.	3.04	0.645	6.36	1.83	0.665	2.15
No. of tests for 95% chance of 1-second accuracy	40	1.8	156	15.45	2.04	77.5
1:16 accuracy	..	..	14	....	....	3.7

exhaustion. It will be noted that in one case 15 tests, and in the other case 40 tests, are required to obtain the same accuracy as *two* tape tests.

The variation (in seconds) obtained with 1-inch squares is greater than with skeins, but since wetting times are longer, this variation should be expressed as a proportion of the sinking time. This places the 1-inch square tests (dropped on surface) intermediate between the tape and skein tests.

Since the tape test is so convenient, it appears to combine the advantages of the skein test with those of the 1-inch square test.

Graphical Representation of Results

The results of tape-wetting tests may be plotted on log-log graph paper in exactly the same manner as the standard Draves test employing skeins, and wetting agents may be compared on the basis of the concentration required to produce 25-second wetting.

Comparison of Tests

That the tape test using a 1.00-gram hook gives a good approximation to the Draves skein test (3-gram hook) is indicated by the tests shown in Table II in which tapes and skeins were run on the same solution.

II. INTERPRETATION OF SINKING TIME TESTS IN TERMS OF PERCENT AIR DISPLACEMENT

It has been pointed out by several authors *(4, 5)* that in the standard Draves test the skein is only partially wet out when it begins to sink. Sinking occurs when the weight of the hook and tape in water is greater than the buoyant effect of the air remaining in the skein.

Examination of the forces acting at equilibrium clarifies this concept and enables us to calculate the percent air displacement in terms of hook weight by determining the displacement of the skein or tape at zero wetting and at complete wetting. (Fig. 1).

TABLE II

		Tape Test 1.0-gm. Hook	*Skein Test 3-gm. Hook*
Nonic 218	*1.0-gm. l.*		
	50°C.	4, 4.5, 4.5, 4.5	3.5, 4, 4, 4
	25°C.	5, 5.5, 5	5, 5.5, 4.5, 5
	0.5 gm./l.		
	50°C.	14, 14.5, 14 14.5	13, 11, 14, 11
	25°C.	20, 20.5, 19, 19	21, 26, 22, 25, 21, 23
Syntholite #170	*1.3 gm./l.*		
	50°C.	7.5, 7.5, 7.5	7, 8.5, 7.5, 8
	25°C.	13, 12.5	12, 10, 11, 12, 13.5
	0.5 gm./l.		
	50°C.	21.5, 21.5, 22.5, 21, 21	20, 21, 23, 31, 23
	25°C.	31, 30, 30, 29 30	40, 33, 43, 40, 37
Syntholite #90	*1 gm./l.*		
	50°C.	22, 22, 22	17, 20, 23, 20, 20
	25°C.	20, 20.5, 20, 19.5	19, 20.5, 21, 19

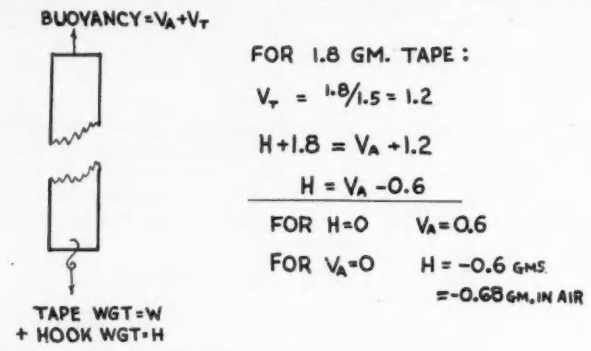
Determination of Air Displacement at Zero Wetting and Complete Wetting

In order to determine the amount of air at zero wetting and at complete wetting, the pan of a triple-beam centigram balance was removed and a counterweight was substituted. The skein or tape, with an anchor hooked to the bottom, was suspended in a 500 ml. graduate filled with water or wetting agent solution by means of a hook and platinum wire so that the anchor did not touch the bottom and the tape or skein did not touch the sides. (For this purpose, the skeins were not cut at the top).

The weight of the hooks and anchor was determined in both air and water and deducted from the corresponding weights with tape or skein in air and water. In order to determine the total air entrapped at zero wetting, it was neecssary to make the readings as rapidly as possible since bubbles continue to rise from the tape or skein, even in the absence of wetting agents. Since there is some uncertainty in this initial reading, it must be recognized that "% wetting-out" figures based on these initial air volumes are an approximation. Typical results are as in Table III.

The relative uniformity of tape vs. skein weights and buoyancies (in water) are compared in Table IV for 10 skeins (commercially supplied 5-gram skeins) and for 13 nine-inch tapes.

The great variation in skein weights, and the deviation from the generally accepted standard of 5 grams (Table IV) is of especial interest, and is undoubtedly a factor contributing to the high variation in skein wetting tests. General practice in reeling off skeins is first to determine the number of yards required for 5 grams and then to run off skeins of the same yardage until the cone of yarn is used up. To those acquainted with the wide variation in yarn number which can occur from skein to skein, the fallacy in assuming that they are all 5 grams is evident, yet it would certainly increase the time required per test if it were necessary to weigh all the skeins and reject those which vary more than a certain tolerance.



H = Hook Weight (in water)
W = Weight of Skein or Tape
V_a = Volume of Air at Equilibrium
V_t = Volume of Tape or Skein

$H + W = V_a + V_t$

(V_t is found by dividing the weight of the tape or skein by the specific gravity of cotton, 1.5)

For a 1.8-gram Tape	For a 5-gram Skein
$V_t = 1.8/1.5 = 1.2$	$V_t = 5.0/1.5 = 3.33$
$H + 1.8 = V_a + 1.2$	$H + 5.00 = V_a + 3.33$
$H = V_a - 0.6$	$H = V_a - 1.67$
For zero hook weight:	
$V_a = 0.6$	$V_a = 1.67$
For 100% air displacement (complete wetting):	
$H = -0.6$	$H = -1.67$

Fig. 1. Equilibrium Calculations. Forces Acting on Tape at Moment of Sinking.

TABLE III

	TAPE BUOYANCIES			*SKEIN BUOYANCIES*		
	Hooks + Tape	*Hooks*	*Tape Only*	*Hooks + Skein*	*Hooks*	*Skein Only*
in air	25.45	23.55	1.90	70.39	65.36	5.03
in water	20.48	22.88	—2.40	46.11	61.60	—15.49
Δ W.....	4.97	0.67	4.30	24.28	3.76	20.52
Completely Wet Out	20.45	21.05	0.60	62.83	61.15	1.68
Δ W			1.30	Δ W		3.35
Specific Gravity = 1.90/1.30 = 1.46				Specific Gravity = 5.03/3.35 = 1.5		
(Corrections for regain would bring the tape weight to about 1.80 and the specific gravity to the accepted value of 1.5)						
(4.30 —1.30 = 3.0 c.c. air in tape 3.0/1.9 = 1.58 c.c. air/gm. tape)				(20.52 —3.35 = 17.17 c.c. air in skein 17.17/5.03 = 3.40 c.c. air/gm. cotton).		

Relation of Hook Weight to % Wetting

The percentage of air displaced for any given hook weight is calculated as in Table V (assuming steel hooks of specific gravity 7.83).

The column "% Air displaced" could be considered as "% completeness of wetting." It is interesting to note that for tapes a 2.75-gram hook will cause instantaneous sinking even in water, and that even for zero hook weight the wetting is only 80% complete.

For skeins, a hook weight of nearly 18 grams would be required for instantaneous sinking in water, and an *unloaded* skein would be 90% "wet out" on sinking.

Under standard Draves Test conditions with 3-gram hook the skein would be "75% wet out", while with a 1-gram hook in the tape modification "wetting-out" is only 51% complete. This factor would seem, at first glance, to favor the skein test; however, the apparently greater "wetting-out" is an illusion based on the fact that the skein contains more than twice as much air per gram of cotton at the outset. Much of the excess air is in the form of large bubbles entrapped in the skein which are released very readily at the beginning of the wetting process; hence, they probably have very little influence on the time required for complete wetting. The fact that a woven tape does not trap such large bubbles, but mostly the much finer bubbles within the cloth structure, itself, is certainly a factor favoring the use of tapes.

Actually a fairer comparison is based on the volume of air remaining per gram of cotton, or on the "apparent specific gravity".

TABLE IV

Tape Weight	*Δ W = Buoyancy*	*Skein Weight*	*Δ W = Buoyancy*
1.31	4.08	5.03	20.52
1.96	4.55	5.20	21.52
1.90	4.45	4.99	20.38
1.91	4.44	4.83	18.50
1.90	4.30	4.96	20.12
1.90	4.54	4.74	19.62
1.96	4.43	4.95	20.93
1.93	4.53	4.00	20.50
1.92	4.58	4.72	19.83
1.86	4.61	4.17	17.33
1.92	4.18		
1.93	4.32		
1.85	4.15		
Avg. 1.87	4.30	4.86	19.93

Evaluation of Commercial Wetting Agents by Varying Hook Weights, Concentrations and Temperatures

In order to study the completeness of wetting-out against sinking time, a series of commercial wetting agents was evaluated by the tape method employing hook weights of 2, 1.25, 0.5, and 0.035 grams the latter, an approximation to zero loading, was obtained by fastening the anchor string to the tape by means of a wire staple. The tests were repeated at 25°, 50°, and 75°C. for a series of concentrations. In virtually all cases, the tape tests resulted in straight line plots on semi-log paper (Log Time vs. Hook Weight). For varying concentrations of the same wetting agent, the lines either converge toward a point (corresponding to hook weight 2.7 to about 4 grams) or are parallel with a break in the high hook weight region to a converging line series. Typical data for Syntholite No. 90 (an alkylryl sulfonate wetting agent) illustrate this behavior (Fig. 2).

On re-plotting the same data as log time against log concentration, in standard Draves test form, the lines for the various hook weights are found to be parallel (lower set of graphs on Fig. 2) confirming the work of Edelstein and Draves *(5)*.

An exception occurs in the 5 gram and 10 gram per liter concentration. Here the slope of the time-hookweight lines has changed slightly, so that they are no longer parallel with the others. This is reflected in a break in the time-concentra-

tion graphs above 3 grams per liter (about 1¼ grams per liter, active basis). It seems likely that this is caused by micelle formation at higher concentrations, resulting in greatly enhanced surface-active properties as evidenced by the steeper slope. At higher temperatures, micelle formation would require a higher concentration, and it is noted that the 5 gm./l. line is nearly parallel with the others at 50°C, and actually becomes parallel at 75°C. and the break in the time-concentration graphs moves over to almost 5 grams per liter.

This wetting agent is ideal for study, since the concentrations of interest in textile work (usually 0.3% or less) yield parallel lines in both sets of curves. The slope of the time-hook weight curves decreases slightly with increasing temperature, while the slope of the time concentration curves shows a very marked decrease (from 56° slope at 25°C. to 27.5° slope at 75°C.). This results in interesting temperature inversion effects where faster wetting is obtained at higher temperatures for low concentrations, and at lower temperatures for higher concentrations. This inversion was noted in most of the wetting agents studied in this report.

The breaks in the time-concentration curves at higher concentrations illustrates a possible risk in extrapolating beyond the known data. If the 5 gram and 10 gram per liter points had not been determined, and the upper parallel lines had been extended to the right to obtain concentrations required for 25-second wetting, an error of about 300% would result in the case of the zero hook weight.

On the other hand, the portion of the time-hook weight curves between 0 and 1¼ grams was almost invariably straight, and the left hand portion of the time-concentration curves is also straight. Hence it looks as though extrapolation to the left is fairly safe for tape tests, especially where the curves are parallel.

By extrapolating the time-hook weight curves towards the left to a point equivalent to 0.6 gram weight in water (equivalent to —0.68 on the hook weight scale) we would obtain the time for *complete wetting out.*

The *complete wetting out time* may be of great importance, especially in dyeing operations where a small percentage of entrapped air might cause resist spots. There also exists the suspicion that wetting agents which are rapid for the first 50 to 75% of air displacement might be poorer for the last 25%, and that the wetting curves would cross. In fact it has been reported that, in general, higher concentrations of wetting agents cause faster initial wetting, but lower concentrations are better for more complete wetting *(4).*

TABLE V

TAPE (1.90 Gms.)

Hook Wgt. in Air	*Hook or Tape wgt. in Water*	*Buoyancy*	*Vol. Air*	*% Air Displaced*	*c.c. Air per gm. Cotton*
2.75	—2.40	4.30	3.0	0%	1.58
	—2.10	4.0	2.7	10	1.43
2.00	—1.70	3.64	2.34	22.0	1.23
1.25	—1.09	2.99	1.69	43.6	.89
	—0.90	2.80	1.5	50.0	.79
1.00	—0.87	2.77	1.47	51.0	.77
0.50	—0.44	2.34	1.04	65.4	.55
0	0	1.9	0.6	80.0	.32
	+0.30	1.6	0.3	90.0	.16
—0.68	+0.60	1.30	0	100.0	0

SKEIN (4.86 Gms.)

Hook Wgt. in Air	*Skein in H_2O*	*Buoyancy*	*Vol. Air*	*% Air Displaced*	*c.c. Air per gm. Cotton*
17.9	—15.59	20.45	17.19	0	3.53
6	— 5.25	10.11	6.85	60.3%	1.41
5	— 4.36	9.22	5.96	65.6	1.23
3	— 2.62	7.48	4.22	75.5	0.78
2	— 1.74	6.60	3.34	80.6	0.69
1	— 0.87	5.73	2.47	86.0	0.51
0	0	4.86	1.60	90.7	0.33
—1.83	+ 1.60	3.26	0	100	0

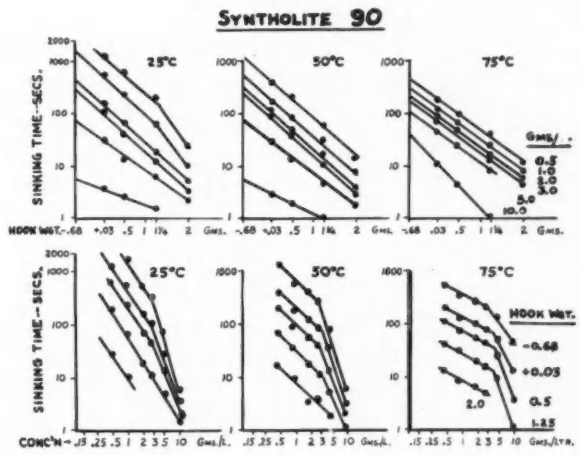


Fig. 2. Sinking Time vs. Hook Weight and Concentration—Syntholite 90.

This conclusion, which is based on skein buoyancies by a special hydrometer method should certainly be viewed with grave alarm by chemical manufacturers, for a casual reader might draw the conclusion that the most complete wetting out would be obtained with *no wetting agent at all!* This concept is examined more carefully on the basis of data obtained by both the variable hook-weight method and the balance-buoyancy method to be described herewith.

To pursue the extrapolation method further, the time vs. hook weight curves were extended to a point corresponding to —0.68 gm. hook weight. At this intersection the time for "complete wetting" was obtained and results were plotted as a separate curve on the time-concentration graph.

A repetition of the variable hook-weight technique, employing skeins instead of tapes, gave the first intimation that skeins

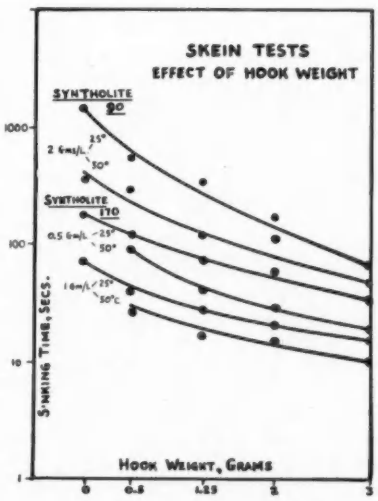


Fig. 3. Sinking Time vs. Hook Weight for Skeins.

behave quite differently from tapes in these tests. With skeins there was very definite upward curvature in the 0 to 0.5 gram hook weight region, indicating a dropping off in wetting speed (Fig. 3). In the case of skeins, no attempt was made to extrapolate to obtain an approximation to the "complete wetting" time. All points on the graphs of Figs. 2 to 8 are averages of not less than three determinations in tap water at 38 p.p.m. hardness.

Results of varying hook weight tests on a number of other commercial wetting agents of known composition *(8)*, evaluated by the tape method, are presented as follows:

Fig. 4—Deceresol OT, 85%.
Fig. 5—Syntholite 170.
Fig. 6—Nekal NS.
Fig. 7—Igepal CA, Ex. High Conc.
Fig. 8—MP189S.

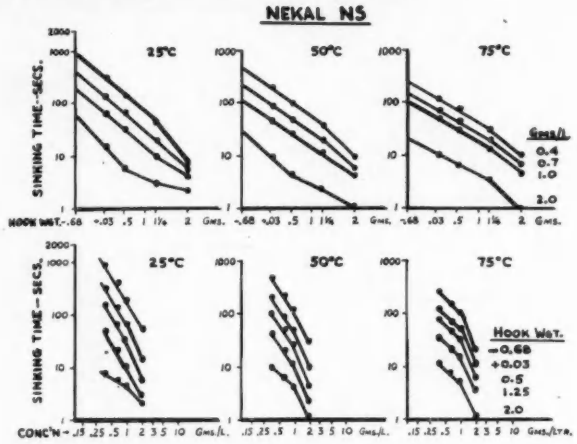


Fig. 6. Sinking Time vs. Hook Weight and Concentration—Nekal NS.

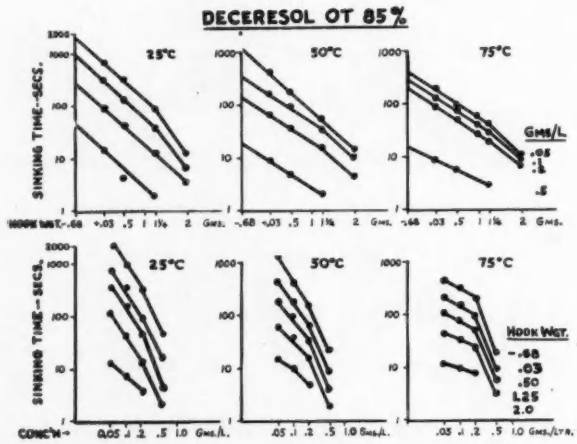


Fig. 4. Sinking Time vs. Hook Weight and Concentration—Deceresol OT 85%.

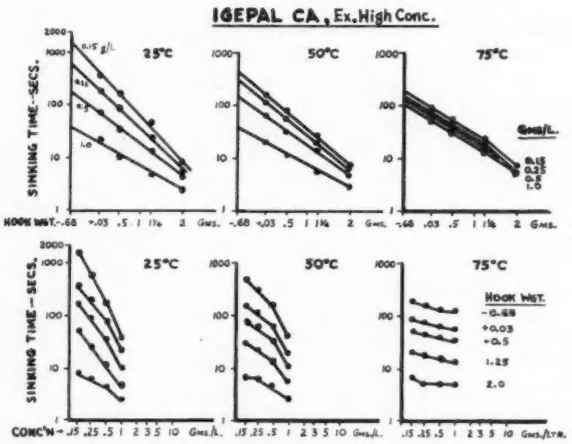


Fig. 7. Sinking Time vs. Hook Weight and Concentration—Igepal CA, Ex. High Conc.

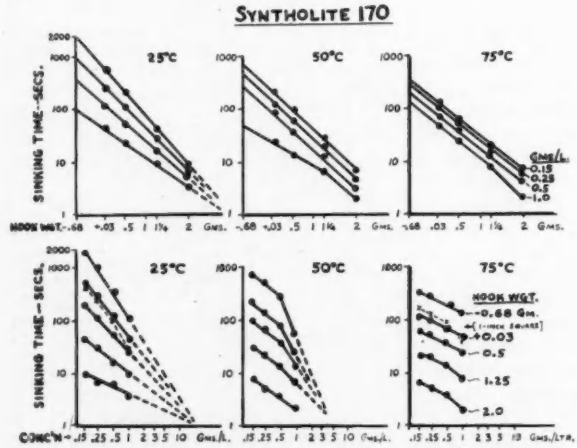


Fig. 5. Sinking Time vs. Hook Weight and Concentration—Syntholite 170.

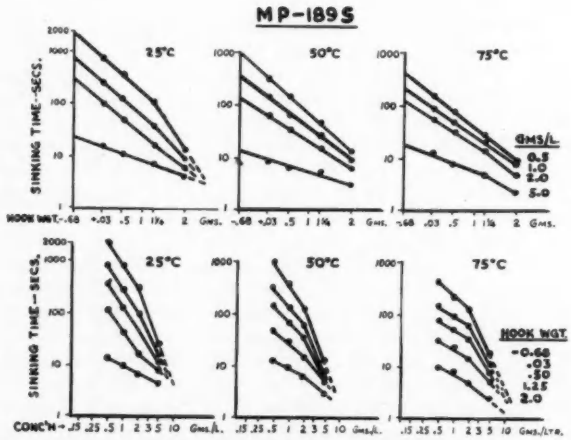


Fig. 8. Sinking Time vs. Hook Weight and Concentration—MP-189S

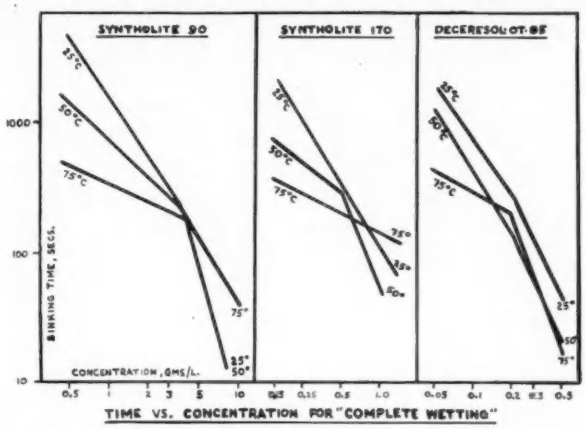


Fig. 9. Temperature Inversion Effect on Sinking Time vs. Concentration.

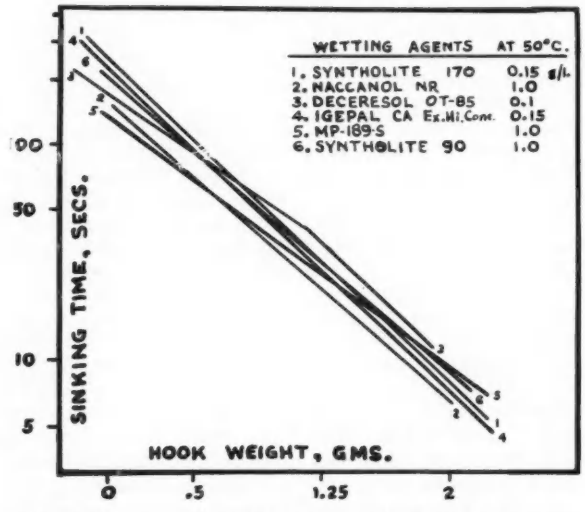


Fig. 10. Crossovers in Sinking Time vs. Hook Weight curves.

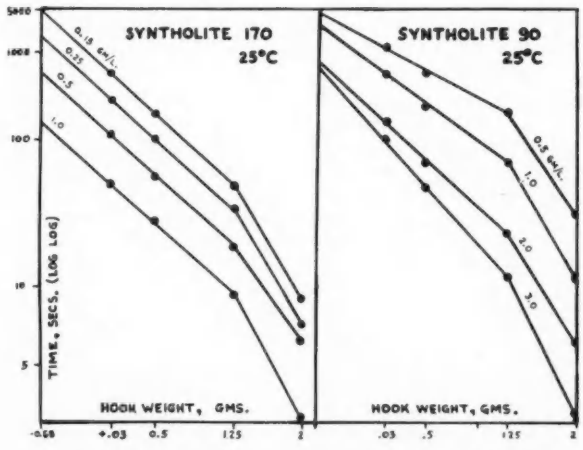


Fig. 11. Syntholite 170. Fig. 12. Syntholite 90. Sinking Time vs. Hook Weight (Log log Time Scales).

Examination of time vs. hook weight curves shows that in general converging lines are obtained at 25°C. and parallel lines at 75°C. At 50°C. the lines may be either converging or parallel. The curves for high hook weight and for high concentrations are often not parallel with the others.

In the time-concentration curves, it is also noted that the higher temperature (75°) favors parallelism, but that the curves converge at lower temperature, or at least break from a parallel series to a converging series at a definite concentration.

Wetting tests for 1-inch squares of the same tape material are plotted in Fig. 5 for several concentrations at 25° and 50°C. Although the slope is not the same as for the tapes, in general the wetting times correspond to 0-gram hook weight. This result would be expected from the analogy with an unloaded tape, since the ratio of buoyant force to tape weight would be the same. A complicating factor, however, is that the wetting proceeds from one face only, and from the edges to the center.

Later work on the buoyancy-balance technique shows that the "complete wetting" time obtained by extrapolation from the hook-weight curves is only a little over 90% complete, obviously due to slowing down of the wetting process toward the end. Typical curves for the wetting agents in Fig. 9 are especially interesting because they all show the temperature inversion effect at higher concentrations.

Crossovers in Wetting Speed Curves

The time-hook weight curves at 50°C., which give roughly comparable wetting speeds for the various wetting agents studied, are plotted in Fig. 10. It will be noted that many of the curves cross, so that one wetting agent might be considered more efficient at incipient wetting than another at more complete wetting. Nevertheless, the slopes are so nearly alike over the range studied that as a first approximation it could be assumed that crossovers are not of great importance, and that the effectiveness of these compounds for initial wetting does not differ greatly from that for more complete wetting.

Since the time-hook weight curves for any single wetting agent do not cross up to zero hook weight, there does not appear to be any inversion in concentrations effective for high percentage wetting out and those for low percentage wetting out, on tape.

To determine the effect of employing

a function other than log T in the time-hook weight curves, graphs were drawn with log log T on the left hand scale. The series of lines which had been converging on the ordinary semi-log plot (Fig. 5—Syntholite 170 at 25°C.) became a set of parallel lines on the log log T graph. (Fig. 11). On the other hand, one series of curves which had been parallel on the semi-log plot converged to the right on the log log T plot, (Fig. 12). If the changes in slope previously observed are due to micelle formation, then it is possible that the nonmicellar solutions follow a log log relation, while the micellar solutions follow a logarithmic relation between concentration and wetting speed.

III. THE BUOYANCY—BALANCE METHOD FOR WETTING SPEEDS

A simple and accurate approach to rate-of-wetting studies is by direct buoyancy measurement on skeins or tapes suspended from a triple beam centigram balance. The tape or skein is suspended in a 500 ml. graduate containing the test solution with a hook or anchor heavy enough to prevent floating. (Fig. 13).

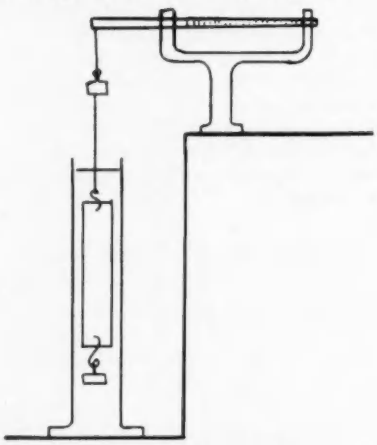


Fig. 13. Buoyancy Balance Arrangement

For the purpose of this discussion and that of the preceding section, *buoyancy* is defined as the *change in weight* of the fabric or skein on immersion in water or test solution for any given length of time. This is equal to the volume of textile material plus the volume of air entrapped at the time of measurement, (i.e. the "apparent volume of fabric").

For temperatures other than room temperature, it would be necessary to immerse the graduate in a constant temperature bath.

The following tests were carried out at 25°C. on commercial wetting agents, at concentrations corresponding to those employed in the variable hook weight tests. The weight of the hooks in air is determined, then subtracted from the weight of the tapes and hooks in air to obtain the tape weight. The weight of the hooks in liquid is determined and subtracted from the various weighings of tape and hooks after immersion in wetting solution. This results in a figure for *weight of the tape in water,* (which is equal to the weight of tape in air minus the buoyancy—, see Table III.) In the graphs in Fig. 14, the weight of the tape in water is plotted against log time. (Fig. 14).

It will be noted that in both sets of graphs smooth curves are obtained which do not cross each other and which are nearly linear up to the zero "weight-in-water" point. After the zero point has been reached, wetting slows up and in most cases the curves converge toward the point of complete wetting (about +0.6). Since the curves are not linear, it is evident that the complete wetting-out times cannot be obtained by extrapolation of the variable hook-weight curves, but the values obtained might be of some value as points of approximately 90% wetting out. Comparison of hook weight data with buoyancy curves shows that the data agree almost within experimental error. The zero hook weight points show somewhat more rapid wetting than would be expected from the buoyancy curves, and the discrepancies from *extrapolated* hook-weight curves become greater as the buoyancy curves flatten out.

Fig. 15 shows an interesting set of time-buoyancy graphs in which time is plotted as a log log function as in Figs. 11 and 12. The fact that the buoyancy curves are very nearly straight-lines (to about 95% wetting out) certainly indicates that this type of plot would be convenient for future investigations. It is especially interesting to note that the curves for the four different wetting agents are nearly parallel, and cross each other only in the case of two curves which are nearly superimposed.

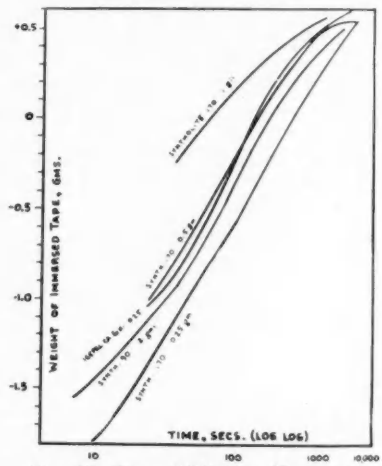


Fig. 15. Rate of Wetting (Buoyancy Method)—Log Log Time Plot.

Since the time-buoyancy curves for the tapes at various concentrations failed to confirm the work of Gruntfest, Hager, and Walker, *(4)* a comparative test was run on tape and on uncut skeins, employing the wetting agent Triton N-100 at three concentrations.

Fig. 16, employing woven tapes, again confirmed the previous tests. The curves did not intersect.

The curves obtained with uncut skeins, however, proved an unequivocal confirmation of the results obtained by Gruntfest, Hager, and Walker. Each curve was repeated twice, and while the skein tests were more difficult to reproduce and showed occasional irregularities, both sets showed the same effect. Somewhere be-

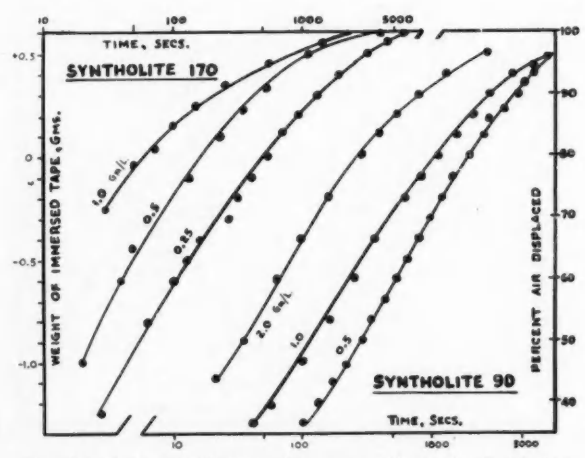


Fig. 14. Rate of Wetting (Buoyancy Method)—Syntholite 170 and 90.

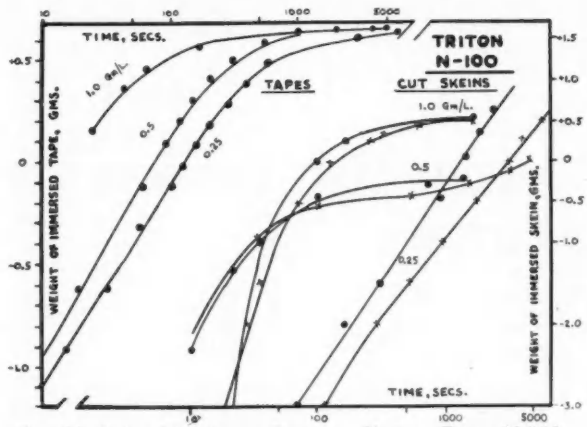


Fig. 16. Rate of Wetting—Tapes vs. Skeins—Triton N-100.

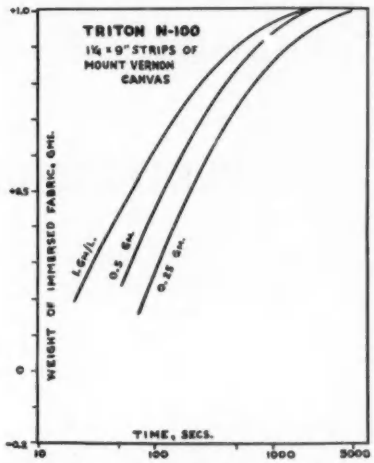


Fig. 17. Rate of Wetting—Mount Vernon Cannon—Triton N-100.

tween 100 and 1000 seconds, the curve for highest concentration levelled off and crossed the others to become the slowest in wetting at higher air displacement. The lowest concentration curve, however, continued its upward climb until it crossed the others and attained a higher percentage wetting out.

The levelling-off of the curve took place some distance below the calculated weight for 100% wetting. They must, however, have continued their slow wetting until completely wet out, since on standing overnight, the weights came to the calculated value of 1.6.

To eliminate the possibility that the *uncut skeins* might be responsible for this behavior, the test was repeated in duplicate with *cut skeins*. In this case the skeins were suspended *from the bottom* by a long thread, and a 10-liter jar was employed, instead of a graduate, to make certain that the skein would not rub against the sides as it unfolded and eventually drooped down. While the curves in Fig. 16 do not *exactly* reproduce those for uncut skeins, they do show the same cross-over effect. The 0.25 gm./l. curve reached +1.2 grams overnight, but on raising and lowering and skein a few times, it reached a final value of +1.67.

This difference in behavior between tape and skeins is quite perplexing. Schwartz and Perry *(6)* have pointed out that the lower surface tension obtained by increasing amounts of wetting agents does not mean that faster penetration into capillaries will be obtained since in capillary systems (e.g., spaces between fibers) of a yarn *which is wet by water* the penetration rate is directly proportional to the surface tension. This means that once enough surface-active agent has been added to insure spreading over the repellent wax surfaces, (i.e., to obtain a contact angle of zero) then any further addition of surface-active agent should reduce the rate of penetration into capillary spaces. Unfortunately this fails to explain the discrepancy when woven tape is used.

The fact that the curves for skeins seem to level off at a false endpoint and then after failing to reach final equilibrium overnight can be brought to complete wetting by merely raising and lowering the skein a few times, suggests that the phenomenon may be caused by entrapment of small air bubbles which have been displaced from the fiber surface but cannot make their way out of the mass of yarns. There would be less likelihood of this occurring in a light woven tape than in a skein or heavy canvas fabric. Another series run with 1¼ x 9" strips of Mount Vernon Canvas (weight 2.9 gms.) showed regular curves which did not cross. (Fig. 17).

This brings out one factor in laboratory evaluation tests which does not parallel the usage of wetting agents in plant practice, namely, lack of agitation. Dyeing operations are invariably carried out with some sort of agitation of the fabric or circulation of the liquor, and this may affect the wetting rates. To confirm this, some method would have to be devised for agitating the liquor without interfering with buoyancy measurements.

IV. REWETTING TESTS BY THE TAPE METHOD

Rewetting tests are accomplished very readily by immersing in the test solution a length of tape sufficient for the required number of tests (plus about 15% to allow for shrinkage and trimming off ends). The tape is then run through a wringer or laboratory padder to obtain the desired pickup.

Since much higher concentrations are employed for rewetting, 2½ to 10 gram per liter (0.25 to 1.0%) were employed in these tests. The tapes were dried at 115°C. and allowed to stand at least overnight before testing. Where it is desired to test for stability to storage tapes are tested after one week to one month or more.

Nine-inch lengths of the impregnated, dried tape are cut and tested exactly as in the wetting test technique, except that water is used as the wetting medium. In order to prevent a concentration of wetting agent from building up in the water, a fresh portion of water is used for each test. This method has the advantage that water at varying temperatures can be employed. The same type is used for the specular reflection technique *(7)*. Typical results are as in Table VI.

The relations between sinking time and specular reflection values is not entirely clear and could be studied further.

(Concluded on Page P62)

TABLE VI

PRODUCT	CONC'N	SINKING TIME 1¼ gm. hook wgt.	SPECULAR REFLECTION
A	1%	2.3 secs.	5 secs.
B	1%	14.2 secs.	35 secs.
C	1%	7.8 secs.	14 secs.
D	1%	1.5 secs.	17 secs.
D	½%	12.3 secs.	44 secs.
E	1%	23.5 secs.	154 secs.
F	1%	8.1 secs.	33 secs.

Cellulosic Group Meeting–

INVESTIGATIONS OF ANTICREASE TREATMENTS FOR COTTON*

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Textile Research Laboratory
Monsanto Chemical Co.

EASE of wrinkling has long been recognized as an undesirable characteristic of cotton fabrics, especially dress goods. The improvement of cotton's resistance to wrinkling has, therefore, attracted considerable attention. Excellent wrinkle resistance can be produced with water-soluble resin finishes of the thermosetting type. However, the improvement in anticrease performance is generally obtained at the cost of reductions in tear and tensile strengths of the goods. The severity of these losses varies from fabric to fabric but, in general, the loss for a given fabric appears to be related to the wrinkle resistance produced.

The variation of fabric strength properties with wrinkle resistance is obviously of considerable practical importance. It is also of theoretical interest because establishment of the mechanism would undoubtedly contribute to the further development of finishes and modifications. The experiments described in this paper were undertaken for the purpose of more precisely defining the practical and theoretical problems involved.

A systematic investigation was made of the effects of melamine formaldehyde precondensate on a standard cotton fabric. A number of application variables were separately varied over wide ranges. This part of the study was designed to show the relative influence of different variables on fabric properties. Subsequent experiments were conducted to elucidate the nature of the action of resin on cotton.

The effects of wrinkle resistance treatments on cotton fabric properties have been widely discussed but the literature contains few reports of a quantitative nature. An excellent survey of the present status of wrinkle resistant cottons, by Buck and McCord *(1)*, appeared recently. They summarized both technical and market aspects and reviewed the development, application, test methods and general effects of resin finishes. There is little to be gained by re-surveying this ground. It is sufficient to note their statement that urea and melamine-formaldehyde resins, which are most commonly used to produce wrinkle resistance, cause losses in fabric strength. They leave open the question of whether or not these losses result from cellulose-to-cellulose cross-linking through resin bridges.

The application of resin finishes, as commonly made, consists of a series of operations. An aqueous solution of the resin precondensate and latent catalyst is padded on the goods which are then generally frame dried, cured, washed, and again frame dried. The final result is dependent on all these steps, each of which is subject to variations in factors such as time, temperature and concentrations. In some steps padder pressures and pulling stresses are among other variables. Finally, like untreated goods the finished fabric may exhibit point-to-point variations in properties that require the averaging of multiple tests for reasonable reliable estimates.

The laboratory study of such a process has at least one advantage over study in the mill in that far greater flexibility is permitted by manual control than can ordinarily be obtained with high speed automatic equipment. On the other hand, curing cycles, for example, can probably be reproduced better in the mill than in the laboratory. Every effort to offset the effects of variations due to manual control was made in the present work by close adherence to a standard procedure.

Materials and Methods

The cotton fabric used was an 80x80 bleached, unmercerized print cloth free from finish. It was chosen because it emphasizes the effects of anticreasing resins.

The melamine-formaldehyde precondensate was regular production Resloom HP. The latent curing catalysts used were regular production Catalysts AB and AC.†

In order to maintain simplicity as far as possible, no wetting agents, softeners, or other treatment assistants were employed.

The treating process was, briefly, as follows: Dry weighed samples of print cloth, 25 inches warpwise by 19 inches fillingwise, were loosely immersed for about one minute in a freshly prepared solution of Resloom and catalyst. The samples were then padded at 160 lbs. per inch of nip, and reweighed. Wet pickups were calculated from weight changes. The wet fabric samples were subsequently mounted on pin frames under just sufficient tension to remove wrinkles. The samples were dried on the frames at 180°F. for 5 minutes, then transferred on frames to a forced circulation, hot-air oven for cure at specified temperature and times.

The cured samples were then removed from frames and washed to remove catalyst residues and other extraneous materials. This wash consisted of 10 minutes at 110°F. in a rotary washer with running suds of Santomerse No. 1 followed by two 10-minute rinses with water at 110°F. The samples were then extracted, pressed dry on a flat ironer, air dried for 4 hours and finally conditioned at 70°F. and 65% RH for at least overnight prior to testing.

Fabric breaking strengths were determined by the A. S. T. M. cut strip method.

Tear values were obtained with the Elmendorf Tear Tester in accordance with CCC-T-191a, TS-4418 June 25, 1947.

Crease angles were measured with the Wrinkle Recovery Tester as described in Monsanto Textile Bulletin T-17 of Dec. 1, 1947.

Five warp and five filling were separately averaged to obtain mean values for each of the tests made. However, scatter diagrams of warp means against the cor-

* Presented at the Cellulosic Fibers Group Meeting, Atlantic City National Convention, October 15, 1949.

† Resloom HP and Catalysts AB and AC are products of the Monsanto Chemical Company.

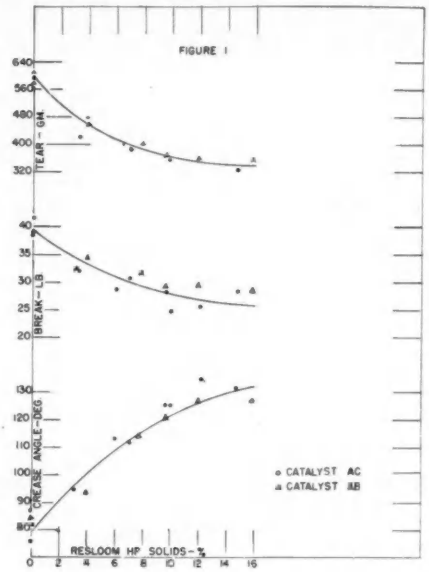

Figure 1

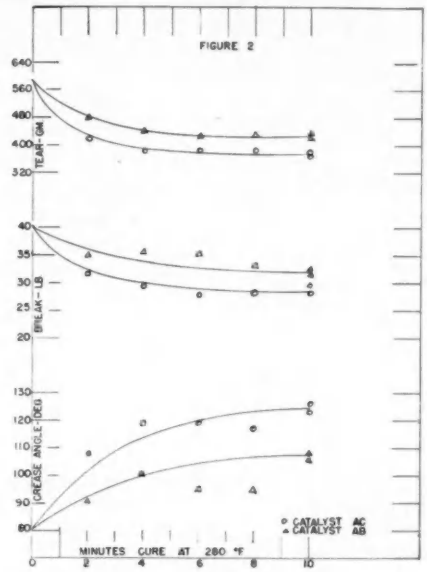

Figure 2

responding filling means later showed that warp and filling means were highly correlated. For this reason corresponding warp and filling values have been averaged, and only single values representing the average of 5 warp and 5 filling tests are reported in the interest of simplification.

The first series of experiments was designed to show the influence of resin solids on fabric properties. Both Catalysts AB and AC were used in parallel applications. Cure in all cases was for 5 minutes at 310°F. The results shown graphically in Figure 1 clearly indicate the nature of the fabric response to varying resin solids.

Cure time and temperature were next investigated. The values shown in Table I were selected from a series in which times were shortened and corresponding temperatures were increased. Again, parallel applications representing the two catalysts were made.

Three facts emerge from these data. First, fabric properties are more dependent upon temperature of cure than upon time of cure.

Secondly, temperature of cure alone can influence results considerably even though other factors are kept constant.

Thirdly, under similar conditions of curing Catalyst AC is more powerful than AB.

A further experiment was conducted in which cure temperature was held constant at 280°F. and time was varied. At this temperature the cure is measurably slow. The results shown in Figue 2 indicate that cure is initially rapid and then slows down nearly to a dead stop. Thus it appears to be established that time of cure has little influence on the results after the initial rapid curing stage is passed.

The effects of different finishing washes were investigated. Duplicate samples were treated and cured in parallel and then given different washes. One sample received the regular 110°F. finishing; the other was given an A.A.T.C.C. cotton wash, that is, 40 minutes at 200°F. The more severe wash causes a significant reduction in crease angle and increase in break and tear over the mild wash. The amounts of these changes are shown by the data on multiple washes in Table II.

Apparently there is little change due to washing after the first severe wash.

Scatter diagrams were prepared of all the data compiled in experiments from which those reported above were selected. Crease angle values plotted against the corresponding tear values are shown in Figure 3 and crease angles against corresponding breaking strengths in Figure 4. Actually, crease angle is probably not directly dependent on either tear or break; therefore such plots should not really be made. However, as long as it is understood that tear and break are not independent variables, the graphs are useful in showing the simultaneous behavior of the pairs plotted.

Within these limitations it apparently is a fact that tear and break generally decrease as crease angle increases. The data involved represent different catalysts, wide variations in resin solids applied, various cure times and cure temperatures, and varying severity of post-cure washing. Yet none of the variations gives results that fall significantly outside the pattern.

TABLE I

Variation of Cure Times and Temperatures Bath: 10% Resloom HP; Catalyst based on HP solids

Solids Add-on %	Catalyst	Cure		Break—lbs.	Tear—gm.	Crease Angle—deg.
		Min.	°F.			
9.3	5%AC	20	250	32.5	400	113
9.4	5%AC	2	340	25.5	352	131
9.6	6%AB	20	250	37.5	464	98
9.3	6%AB	2	340	29.	368	121

TABLE II

Effects of Multiple Washes on Crease Angle

15.4% HP Solids applied—Catalyst AC

	Crease Angle Degrees
After Mild Finishing Wash	131
After 3 Severe Washes	124
After 5 Severe Washes	127

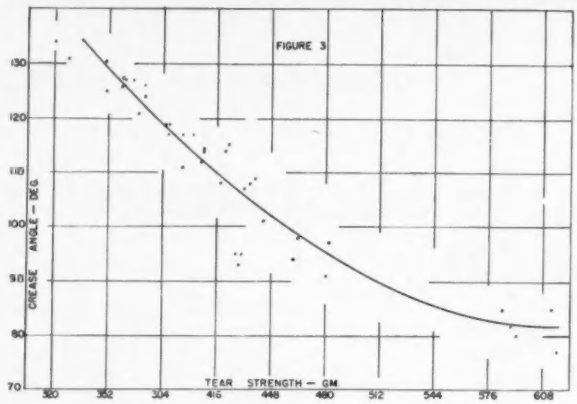

Figure 3

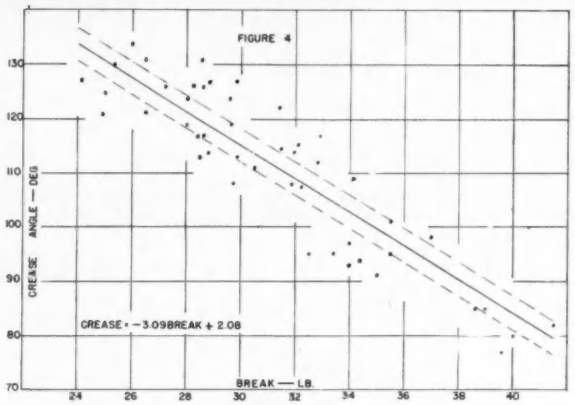

Figure 4

The thought is frequently expressed that the observed strength losses are caused by tendering of the cotton, that is, through acid liberated by the catalysts at cure temperatures. This assumption does not seem tenable in the present case because Resloom HP cures in the pH range 5.0-5.8. For this reason a simple experiment was undertaken. Duplicate samples of fabric were treated in parallel. One of the pair was then stripped of resin with an aqueous 1.5% phosphoric acid—5% urea mixture at 180°F. for 20 minutes and rinsed thoroughly. Both stripped and unstripped samples were subsequently give a finishing wash in the regular manner and conditioned and tested in parallel with an untreated control sample. The data so obtained are shown in Table III.

Strength and tear fall and crease angle rises as a result of the resin treatment but returned very nearly to the untreated values after the resin is stripped. This recovery, particularly of original strength, is conclusive evidence that appreciable tendering or permanent acid damage does not occur in the case of melamine-formaldehyde precondensate.

It is reasonable to assume that the resin rather than the catalyst is responsible for strength and tear reductions. An experiment was run to test this assumption and to determine whether or not the mere physical presence of the precondensate in fibers plays a part. Two similar pieces of standard cotton cloth were treated and tested in parallel. One piece was padded through an aqueous bath containing melamine-formaldehyde precondensate, but no catalyst; the other was padded through water. The pieces were then framed, and dried but not washed prior to being conditioned and tested. The test data are shown in Table IV.

The fabric properties measured are not appreciably altered by the presence of unpolymerized resin.

The effects of polymerizing the resin were then examined. Two similar pieces of the cotton were impregnated as usual with melamine-formaldehyde precondensate and Catalyst AC, framed and dried. One piece was cured in the regular manner for 5 minutes at 300°F. The other piece was cured for 10 minutes in an autoclave with steam at 55 psi. (303°F.). The samples were given the usual finishing wash and tested after being dried and conditioned. In addition to the regular tests, portions of the fabric were subjected to analysis for nitrogen. Finally, small samples of control and treated fabrics were mercerized without tension in 20% caustic and the resulting area shrinkage were determined. The data emanating from these tests are presented in Table V.

The noteworthy features of these data are as follows:

(a) Steam at 300°F. fixes about 2/3 as much resin as dry heat at the same temperature.

(b) Steam curing gives break and crease angle values not appreciably different from the untreated control.

(c) The reduction in tear caused by steam curing is less than half that caused by dry heat curing.

(d) The steam-cured sample is similar to the control in mercerization shrinkage.

(e) Relatively large break and tear losses, a significant increase in crease angle, and low mercerization shrinkage occur only in the dry heat cure.

These results clearly indicate that at least two processes are involved. One is an insolubilization of the resin which can take place as in steam curing without any major effect on break, crease angle, or mercerization shrinkage. The other process, which apparently requires hot anhydrous conditions, causes the development of break loss, crease angle improvement and reduction in mercerization shrinkage.

Discussion

The interpretation of the facts established by this investigation is not particularly difficult to make. It appears that two reactions occur in the anticreasing treatment. First, the resin precondensate reacts with itself under the influence of the acid-liberating catalyst to form an insoluble polymer. This reaction can readily take place in the presence of water as can easily be demonstrated by a simple laboratory experiment. A polymerization of this kind may occur in the anticreasing process during the drying stage and in the initial phase of curing.

The second reaction appears to be a condensation of the resin with cellulose. This reaction requires anhydrous conditions which eliminate water and drive the reaction in the direction of further condensation. Such a condensation is consistent with the behavior of methylol melamines which can be condensed with al-

TABLE III

Properties of Resin-Treated and Stripped Cottons

	% Resin Solids Applied	Breaking Strength—lbs.	Tear Value Grams	Crease Angle—Deg.
Untreated Control	0	45.7	577	72
Treated	9	32.9	400	123
Treated and Stripped	9	44.8	596	74

TABLE IV
Effects of Uncured Resin Precondensate on Cotton

Treatment	% Resin Solids Applied	Break—lbs.	Tear—Grams	Crease Angle Deg.
Water	0	45.4	570	76
Resin Precondensate	9.2	44.4	579	73

cohols under anhydrous conditions to form the so-called ethers. It is sufficient to add, therefore, that cellulose is a polyhydric alcohol.

Actually the resin-cellulose condensation must ultimately yield cellulose-to-cellulose cross bonds through resin bridges. In the case of melamine resin these cross links are highly stable to alkali and hence even in the presence of mercerizing caustic prevent swelling and sharply restrict mercerization shrinkage. In the absence of such cross links, but with polymerized resin present, there is no restraint on swelling and mercerization does produce shrinkage.

Cross-linking of cellulose through resin bridges apparently is necessary to give anti-crease effects. This accords with general principles of polymer behavior in that cross-linking reduces plasticity or flowability. In cotton the plasticity or tendency to accept deformations is obviously responsible for the lack of wrinkle resistance. However, in addition to reducing plasticity, cross-linking also produces more rigid structures which are more perfectly elastic than the unlinked material, but the elasticity is short range. Thus, cross-linking of cotton through resin applications causes a reduction in fiber stretch but an increase in short range elasticity.

This interpretation supports the similar conclusion recently drawn by Cameron and Morton *(2)*. Larger and larger amounts of applied resin cured at higher and higher temperatures should favor cross-linking and do indeed produce greater and greater crease angles. However, the reduction in fiber stretch which accompanies this cross-linking is probably the primary cause of strength and tear losses. For this reason strength and tear vary inversely with crease angle as has been shown.

The existence of resin-fixing and cellulose cross-linking steps in the anticrease process is of considerable practical significance. It means that different degrees of cure can produce different amounts of cross-linking with the same amount of fixed resin. It also means, as the present work shows, that variations in extent of cross-linking caused by variations in cure are probably the major cause of variations in the results.

Summary and Conclusions

Systematic laboratory applications of melamine formaldehyde precondensate were made to a standard cotton cloth. Resin solids, cure time, cure temperature, and post-cure washing were varied separately over wide ranges. The effects on fabric behavior of applying and stripping resin, of depositing unpolymerized resin solids, and of curing with dry and moist heat were determined.

The following conclusions are drawn:

1. Wrinkle resistance of cotton fabric varies inversely with breaking strength and tear value over a wide range of solids applied, cure times, cure temperatures, and post cure washing.
2. Malamine-formaldehyde precondensate properly applied with acid-liberating catalyst causes no apparent acid damage to cotton goods.
3. Deposition of unpolymerized melamine-formaldehyde precondensate has little effect on fabric properties.
4. Simple polymerization of melamine formaldehyde precondensate insolubilizes the resin and causes a small decrease in tear value, but does not alter strength or wrinkle resistance appreciably.
5. Anticrease effects in cotton are produced in proportion as cellulose is cross-linked through resin bridges.
6. Cross-linking requires anhydrous cure conditions and is favored by increases in resin, cure temperature, and catalyst activity.
7. The cellulose-melamine resin bond is extremely resistant to alkali and is not broken by mercerization caustic.
8. Variations in cure conditions which alter the degree of cross-linking of cellulose with resin are probably the major cause of variations in application results.

The author acknowledges with pleasure a debt of gratitude to Mary A. Goodwin and K. L. Sullivan for most of the experimental work, to F. L. Matthews, E. H. Rossin, and M. J. Scott for suggestions and help in developing the program, and to Monsanto Chemical Co. for permission to present the results.

TABLE V
Effects of Steam and Dry Heat Cures of Resin

Treatment	Resin Solids Applied%	Nitrogen Content%	Area Shrinkage on Mercerization %	Breaking Strength-lbs.	Tear Values-Gm.	Crease Angle Deg.
None-control	0	0	23.5	45.4	605	76
Dry heat cure	9.2	4.3	2.6	30.5	354	125
Steam cure	9.1	2.7	20.2	43.9	495	82

Literature Cited

(1) Buck, G. S. and McCord, F. A., Textile Research J, 19, 216 (1949)
(2) Cameron, W. G. and Morton, T. H., J. Soc. Dyers Colourists, 64, 329 (1948).

Open Discussion

Mr. Nuessle: In Dr. Nickerson's introductory remarks he made reference to the paper by Mr. Gagliardi and myself, presented yesterday. We did not claim to be able to crease-proof all rayons or cottons through chemical cross-links alone. We tried to make it clear, in the short time we had for a long paper, that physical cross-linking could also give the same effect or a similar effect.

In the case of Resloom HP, it would be very difficult to prove that the effect was due to chemical cross-linking, because HP will react very readily with itself if allowed to stand around in a wet condition. If you use an acid catalyst, conducive to the action of formaldehyde with cellulose, you are going to get some cross-linking without any question.

You might not have noticed it yesterday, but one slide showed the use of a resin with an alkaline catalyst, sodium carbonate. In that case, creaseproofing was obtained on rayon, even though chemical crosslinking was not likely.

On the acid side, with a formaldehyde compound you are bound to get some cross-linking. Cotton is not chemically different from rayon; the difference is probably due to much greater crystallinity of cotton, and the fact that in your treatment where you get either physical or chemical action the action is not uniform. We pointed out that formaldehyde would be ideal for the purpose if you could make the action uniform and the formaldehyde not so volatile.

I do not have these comments in proper form. I was listening to your lecture at the time I jotted these notes. But I don't think that, taking your data and our own, there are any contradictions whatsoever.

The papers supplement each other.

Mr. Nickerson: I am sure they do. What I wanted to point out was that it would be an error on your part to generalize, on the basis of what you see in the case of viscose rayon, to the behavior of all cellulosic materials, because your strength in the case of viscose may increase, whereas in cotton you have an entirely different situation due to just the causes you mentioned, the difference in crystallinity.

I think it would be an error to imply that since they are all cellulose, they all should behave alike. Actually the mechanics may be the same, but the effects on the cloth are quite a bit different.

Mr. Auer: I would like to clarify a couple of points which I do not think Dr. Nickerson has solved rightly, and I want to express my full appreciation for the actual work he has done. I am debating only the conclusions.

As you see here, I have two cigarettes in my hand which I just picked out of my pocket. If I bend this cigarette with a little bend, it breaks. If I use the cellophane package around the cigarette and bend it with that wrapped around this cigarette, I can bend it 100 per cent, yet after that I can smoke it. Nothing happened.

I am a very great enemy of the generalization of this cross-linking business. The work Dr. Nickerson has just shown us, shows very beautifully and very excellently that he can recover the original property of the cotton with nothing happening to the cotton. If anything, the cotton would be harmed if anything had happened, and it is very unlikely that the cross-linking would be made retroactive, so to say.

However, what happens here is that the differences in the curings of the two resins do not show cross-linking and it is not cross-linking, in my opinion. They show two different resins. It is known that thermoplastic resins show a different result, and we can easily imagine that the melamine resin has two different types of end result if you cure it once in steam and once dry.

But the difficulty is that you actually form an envelope around the fiber, and the envelope unfortunately is not elastic enough. What that means can be shown in the contrary. Anybody who does microscopic work knows that if you want to make a cross-section of a plant or a fiber or anything else, you imbed it in shellac, which is brittle, and you make a beautiful cross-section which you could not do otherwise.

Therefore, if your envelope is brittle, you reduce tensile strength, you reduce primary abrasion resistance, and the abrasion resistance is one of the greatest disadvantages.

So if you plasticize properly in the forms which do not wash out with resins —you cannot work with glucose because the glucose would wash out—if you produce a resin which is washable I think the crush-proofing would be obtained without the disadvantages of reduction in tear and abrasion resistance.

Mr. Nickerson: I would like to disagree as violently with Mr. Auer as he disagreed with me. In the first place, if we take this envelope idea with the cigarette, it is attractive, but you realize that the breaking radius or the bending radius is much different in a cigarette from what it is in a cotton fiber.

The idea that melamine resin forms a film which reduces the abrasion is susceptible to experimental attack. All you have to do is take a thermoplastic resin and apply it to cotton, for example, and put a film on your fibers. You will find the abrasion resistance has gone up, not down.

I think all these points are susceptible to experimental resolution. After a number of years we have come to the conclusion that it is a true cross-linking internal in the fiber. We realize if you apply pre-polymerized resin you do get stiffness and perhaps you get some of the effects that Mr. Auer mentioned; but you do not get increase in the elasticity from the surface of material.

I think that perhaps Mr. Nuessle will tell us that even with formaldehyde you get a sharp increase in crease angle. I think that is one case where almost everyone is agreed there is cross-linking.

Mr. Nuessle: I agree 100 per cent with you, that as far as we know, there are no external or non-diffusible resins that can give crush-proofing. They must always be diffusible. The other experiment is very thought-provoking, but I don't think you can do that with a resin.

Mr. Stevenson: On your dry cured cotton, is it possible to remove the resin by stripping? And if so, how does that affect your cross-linking conclusions?

Mr. Nickerson: The stripping experiment that I showed was of dry cure. There was only one wet cure. You can strip the resin out very readily in either case. As a matter of fact, one that has been cured in moist atmosphere will dye. It will take up the dye, which indicates of course that it will swell and the dye can penetrate, just as the caustic swelled it and caused a shrinkage. The stripping actually applies to dry cure. There was only one wet cure involved, and that was in the last experiment.

Mr. Stevenson: Is it possible to take your wet cured fabric and, at a later time, give it the dry cure, and get the same relative effects?

Mr. Nickerson: We did that. As a matter of fact we baked half the sample after it had been steam cured, and got appreciable increase in crease angle and a lowering in strength and a lowering in tear, but it was not equivalent to what we expected.

Our feeling was that perhaps the condensation of steam on the cloth during the autoclaving had taken out some of the resin pre-condensate and some of the catalyst, too. If we reapplied catalyst I am convinced we would have pushed it right up again. We did not want to get the experiment too involved, and left it as clean as possible.

Mr. Weiss: Dr. Nickerson, you showed us data for the permanence of the melamine finish to the cotton A.A.T.C.C. wash. How permanent would that finish be t a moderately high pH?

Mr. Nickerson: The alkali resistance is very good. Even 20 per cent mercerization caustic failed to cause swelling, so we can say that a high pH is not detrimental.

Mr. Weiss; You have not performed experiments in washing it, though?

Mr. Nickerson: Our washes were done at pH 10 or 9½, I think. Our A.A.T.C.C. cotton wash represents a mixture of tetrasodium pyro phosphate synthetic detergent.

Mr. Rutherford: I am not entirely convinced that you get the cross-linking you talked about, but perhaps it would not take many more experiments to really convince me.

The thing I wanted to ask is, have you tried mercerized cotton? Do you find you get better crease values with mercerized cotton than with unmercerized? Is it harder to get a higher crease angle in unmercerized cotton?

Mr. Nickerson: The answer, I think, is no. If you use mercerized cotton as compared to unmercerized cotton, you will get approximately the same result, or perhaps a little lower value with your mercerized than with your unmercerized. I think the reason is that accessibility is greater in mercerized—the amount of cellulose available, the spaces in which your resin can be distributed. The volume through which it can be distributed is greater in the case of mercerized than it is in unmercerized, and is greater in rayon than in unmercerized.

You will find it takes more to reach the threshold as the accessibility increases. I think it is perhaps quite reasonable, too, that if you localize it, you need less. As you increase the size of the place where it can go, you will need more to get the same result—not very

(Concluded on Page P62)

Report of Committee on

PILOT PLANT EQUIPMENT

Committee
Henry A. Rutherford, *Chairman*
Elliot Broadbent
John N. Dalton
T. R. Smith
R. S. Stribling
Percival Theel
P. J. Wood

Abstract

A great deal of technical work is done in laboratories which have no facilities to allow of plant scale checking. Much A.A.T.C.C. committee work is done in such laboratories and it has been difficult for committee members to scout around and find suitable equipment for checking their laboratory processes or results.

Recognizing this impediment to the completion of authoritative research programs under A.A.T.C.C. auspices, the Executive Committee on Research appointed a committee to survey available pilot plant equipment and the willingness of its owners to cooperate in making trial runs which A.A.T.C.C. might request in connection with its research program.

This committee has completed its work and submitted its report which is now published.

THIS Committee was organized to make a survey of pilot plant equipment available throughout the textile and allied industries. The principle duty of the Committee was to find out what types of equipment were in existence and to what extent the various mills, dyestuff companies, educational institutions, and manufacturers of textile chemicals would be able to cooperate in making any trial runs which the A.A.T.C.C. might desire in connection with its research program.

It was agreed by the Committee members to initiate the survey by sending out a questionnaire to the concerns presumed to have pilot plant equipment. Each questionnaire was accompanied by a letter stating the purpose of the survey. A copy of the letter and questionnaire follows:

* * * *

Dear Sir:

The executive Committee on Research of the American Association of Textile Chemists and Colorists, of which J. K. t Bonnar is Chairman, has set up a Committee to survey pilot plant equipment available throughout the textile and allied industries. We are interested in finding out what types of equipment are in existence, and to what extent the various plants would be able to cooperate in making any trial runs which the A.A.T.C.C. might desire in connection with its research program. It is planned to survey, in addition to various mills, the educational institutions throughout the country, the dyestuff manufacturers, and manufacturers of textile chemicals. The committee is composed of the following men: Elliot Broadbent, John Dalton, R. S. Stribling, T. R. Smith, P. J. Wood, Prof. Percival Theel, and the writer as chairman.

We are enclosing herewith a questionnaire which we should like to have you return to us as soon as possible. It is naturally understood that in revealing to us the pilot plant equipment which you have available, you will in no way commit yourself to the A.A.T.C.C. for the use of this equipment. In many instances, the name of the equipment together with that of the manufacturer is sufficient to describe a machine; in such a case, a detailed description will not be necessary. If the piece is not a "standard" unit we would appreciate a detailed description of it. Any comment which you care to make in connection with this survey, or suggestions which you may have, will be greatly appreciated.

Very truly yours,
Henry A. Rutherford, Head
Department of Textile
Chemistry and Dyeing

QUESTIONNAIRE
PILOT PLANT EQUIPMENT

In filling out this questionnaire *you do not obligate yourself or your organization* to cooperate with the A.A.T.C.C. in making pilot plant trials.

1. Name of organization .....
2. Address .....
3. Person responsible for equipment
..... Name
..... Title
4. List of pilot or laboratory scale equipment and name of manufacturer. (Use back if more space is required.)
5. If any of the above items are not standard equipment, list below, using the proper letter of identification, the specifications of your equipment, etc. Include dimensions, construction, capacity, type of heating, and any other pertinent information. If possible, send a photograph or sketch.
6. Would company policy permit the use of your pilot plant equipment in connection with the A.A.T.C.C. Research Program? An answer in the affirmative does not commit you to its use.
7. Comments or suggestions.

* * * *

The above were sent to all of the corporate members of the A.A.T.C.C. listed in the 1946 yearbook of the Association. In addition, the following were contacted:

C. B. Ordway
Burlington Mills Co.
Box B-2
Greensboro, N. C.

C. Norris Rabold
Erwin Mills, Cooleemee, N. C.

Joseph Lindsay, Head
Textile Chemistry & Dyeing Dept.
Clemson College
Clemson, S. C.

Kenneth R. Fox, President
Lowell Textile Institute
Lowell, Massachusetts

Southern Regional Research Laboratory
2100 Robert E. Lee Blvd.
New Orleans 19, La.
Att: W. M. Scott, Director

Western Regional Research Laboratory
800 Buchanon St.
Albany 6, California
Att: Dr. M. J. Copely, Director

School of Design
Providence, R. I.

Prof. Percival Theel
Philadelphia Textile Institute
Phila, Pa.

H. A. Dickert, Director
A. French Textile School
Georgia School of Technology
Atlanta, Georgia

Northern Regional Research Laboratory
825 N. University St.
Peoria 5, Illinois
Att: G. E. Hilbert, Dir.

Eastern Regional Research Laboratory
Chestnut Hill Station
Philadelphia 18, Pennsylvania
Att: P. A. Wells, Director

Bradford-Durfee Technical Institute,
Fall River, Massachusetts

School of Textiles
North Carolina State College
Raleigh, North Carolina

The response to the questionnaire was exceedingly good and it was learned that only a relatively few concerns had pilot plant equipment available. The following is a list of those from whom a reply was received and who, at the same time, have pilot plant equipment which could be made available to the A.A.T.C.C.:

Aberfoyle Manufacturing Company
Chester, Pennsylvania
L. A. Stead, Gen. Mgr.

Better Fabrics Testing Bureau, Inc.
101 West 31st Street
New York, New York
Frank Stutz, President

Bradford Dyeing Association
P. O. Box 539
Westerly, Rhode Island
J. A. Stevenson, Supt.

Burkart-Schier Chemical Co.
13th and Chestnut Streets
Chattanooga 2, Tennessee
A. J. Kelly, Chief Chemist

Joseph Bancroft & Sons Company
Rockford, Wilmington 99, Delaware
Arnold L. Lippert, Vice-Pres.,
Research and Development

Bradford Durfee Technical Inst.
64 Durfee Street
Fall River, Massachusetts
Leslie P. Coombs, Principal

Buffalo Electro-Chemical Co., Inc.
Station B.
Buffalo 7, New York
Dr. H. O. Kauffmann, Director of Research

H. W. Butterworth & Sons Co.
York and Cedar Streets
Philadelphia, Pennsylvania
Edward S. Pierce, Asst. Sales Manager

Cannon Mills Company
Kannapolis, North Carolina
V. B. Holland, Research Director

Carbic Color and Chemical Co.
451 Washington Street
New York 13, New York
E. A. Lutz, Chief Chemist

Ciba Company, Inc.
Greenwich and Morton Sts.
New York 14, New York
M. G. Stern, Chief Chemist

Cold Spring Bleachery
Yardley, Pennsylvania
J. Marshall Cole, Vice-Pres.

Commonwealth Color & Chemical Co.
Nevins, Butler & Baltic Sts.
Brooklyn 17, New York
Martin W. Mueller, Chemist

Cooper, Wells & Company
St. Joseph, Michigan
Marian Kesterke, Rolande Oper.

N. Erlanger Blumgart & Co., Inc.
356 Fourth Avenue
New York 10, New York
Walter Bornstein, Technician

A. French Textile School of the Georgia School of Technology
225 North Avenue, N.W.
Atlanta, Georgia
Herman A. Dickert, Director

Glenylon Print Works
Phillipsdale, R. I.
James Shore, Chief Chemist

Harris Research Laboratories
1246 Taylor Street, N.W.
Washington 11, D. C.
Milton Harris, Director

Lowell Textile Institute
Lowell, Massachusetts
Charles L. Howarth, Asst. Prof.

National Aniline Division, Allied
Chemical & Dye Corporation
Technical Service Div.
40 Rector Street
New York 6, New York
W. A. Holst, Technical Service Mgr.

Cantor Greenspan Co., Inc.
469 Seventh Avenue
New York 18, New York
Max Schuster, Director, Quality Control and Development

Celanese Corporation of America
180 Madison Avenue
New York 16, New York
R. Burns

Clemson College
Clemson, South Carolina
Joseph Lindsay, Jr., Head, Textile Chemistry and Dyeing Dept.

Collins & Aikman Corporation
51st and Parkside Avenue
Philadelphia 31, Pennsylvania
W. F. Bird, Director, Research Technical Control

Continental Mills, Inc.
Armat and Lena Sts.
Philadelphia 20, Pennsylvania
Alfred F. Fulgundruger, Chief Chemist

Cranston Print Works Company
Cranston 9, Rhode Island
E. W. Lawrence, Dir. of Research

Forstmann Woolen Company
Passaic, New Jersey
Werner Von Bergen, Dir. of Research

The Geigy Company, Inc.
89 Barclay Street
New York 8, New York
D. P. Knowland, Chief Chemist

Graniteville Company
Graniteville, South Carolina
Sherman Converse, Research Director

Jacques Wolfe and Company
Passaic, New Jersey
Arnold Pfister, Superintendent

Mock, Judson, Voehringer Co. of North Carolina, Inc.
Howard & Hiatt Sts. (P. O. Box Q-1)
Greensboro, North Carolina

North Carolina State College
Raleigh, North Carolina
Henry A. Rutherford

Nova Chemical Corporation
147-153 Waverly Place
New York 14, New York
C. A. Funke, Vice-Pres.

Pacific Mills
Lyman, South Carolina
R. E. Rupp, Superintendent

Procter & Gamble Chemical Div.
Ivorydale 17, Ohio
B. A. Ryberg, Textile Research Department

Rit Products Corporation
1401 W. Jackson Boulevard
Chicago 7, Illinois
Elliott Morrill, Technical Director

Sandoz Chemical Works, Inc.
61 Van Dam Street
New York 13, New York
James C. Walker, Vice-Pres.

Soo Valley Company
Estherville, Iowa
E. W. Robinson

Swift Manufacturing Company
Columbus, Georgia
Garland Embry, Jr., Designer

Waldrich Company
Delawanna, New Jersey
K. W. Roy, Plant Engineer

Research Division
West Point Manufacturing Co.
Shawmut, Alabama
Howard M. Waddle, Head of Chemical Department

William Whitman Company, Inc.
Arlington Division
500 Broadway
Lawrence, Massachusetts
Hugh Christison, Chemist

Calco Chemical Division
American Cyanamid Company
Bound Brook, New Jersey
Dr. A. L. Peiker, Manager Dyes Technical

General Dyestuff Corporation
435 Hudson Street
New York 14, New York
E. J. Deane, Methods Engineer

Nyanza Color and Chemical Co.
109 Worth Street
New York 13, New York
R. H. Skinner, Chemist

Phoenix Hosiery Company
320 East Buffalo Street
Milwaukee 1, Wisconsin
A. J. Olson, Dyer

Providence Dyeing, Bleaching and Calendering Company
52 Valley Street
Providence, R. I.
Richard H. Lewis, Chief Chemist

S. and M. Dye Works, Inc.
3419 Richmond Street
Philadelphia 34, Pennsylvania

Scholler Brothers, Inc.
Collins and Westmoreland Sts.
Philadelphia 34, Pennsylvania
L. O. Koons, Vice-Pres. & Treas.

Alexander Smith & Sons Carpet Co.
Saw Mill River Road
Yonkers 1, N. Y.
J. A. Pfay, Research Engineer

Venango Engineering Co., Inc.
G and Lycoming Streets
Philadelphia 24, Pa.
C. Harry McCandless, Sales Mgr.

Watson-Park Company
Box 158
Ballardvale, Massachusetts
Howell F. Shepard, Treas.

Wiscassett Mills Company
Albemarle, North Carolina
T. R. Smith, Manager, Yarn Dyeing Department

American Viscose Corporation
Marcus Hook, Pennsylvania
James A. Woodruff

E. I. du Pont de Nemours and Co.
Technical Laboratory
P. O. Box 386
Wilmington 99, Delaware
George H. Schuler, Director

Rhode Island School of Design
Providence 3, Rhode Island
William D. Fales, Director Textile Div.

Southern Regional Research Laboratory
Bureau of Agr. and Ind. Chemistry
U. S. Department of Agriculture
2100 Robert E. Lee Boulevard
New Orleans 19, La.

The equipment which was available is listed below in the following scheme:

I. DYEING EQUIPMENT
- A. Knit Goods
  1. Paddle
  2. Rotary Hosiery
- B. Piece Goods
  1. Beck, Laboratory
  2. Jig, Laboratory
  3. Pad Steam
- C. Raw Stock
  1. Kettles
  2. Miscellaneous
- D. Wool Top
- E. Yarn
  1. Package
  2. Skein

II. FINISHING OR WET PROCESSING EQUIPMENT
- A. Calenders
- B. Driers
- C. Folders
- D. J. Box
- E. Kier
- F. Padders
- G. Singe
- H. Slasher, Laboratory
- I. Tenter Frames
- J. Washers

III. MANUFACTURING EQUIPMENT
- A. Cotton (or Synthetics)
  1. Carding, Spinning, Weaving, etc.
  2. Knitting

IV. PRINTING EQUIPMENT
- A. Agers and Steamers
- B. Roller Machines

V. RESEARCH EQUIPMENT, SPECIAL
- A. High Frequency Generators
- B. Spectrophotometers

VI. TESTING EQUIPMENT
- A. Accelerated Fading Units
- B. Gas Fading
- C. Launderometer
- D. Miscellaneous Testing Apparatus
- E. Textile Testing Laboratory, Complete

I. DYEING EQUIPMENT

A. Knit Goods

1. Paddle

Burkart-Schier Chemical Company (Strickland)
Scholler Brothers, Inc. (Smith-Drum, hosiery, 3 to 5 doz. capy.)

2. Rotary Hosiery

N. C. State College (Smith-Drum)
Clemson College (Strickland, 10 pounds capy.)
Commonwealth Color and Chemical Company (Smith-Drum, 10 pounds capy.)
Mock, Judson, Voehringer Co. (5 pounds capy.)

B. Piece Goods

1. Beck, Laboratory

Bradford Dyeing Assoc. (5" face)
H. W. Butterworth & Sons Co. (Stainless Steel 18" face)
Celanese Corporation of America (Williams Unit)
Clemson College (Rodney Hunt, 200 pounds)
The Geigy Company, Inc. (Grand Rapids Textile Machinery Co.)
N. C. State College (Rodney Hunt Sample)
Sandoz Chemical Works, Inc. (20 yards capy.)

Waldrich Company
Bradford Durfee Technical Institute (Riggs & Lombard, 2 yards to full piece capy.)

2. Jig, Laboratory
Joseph Bancroft and Sons Company
Bradford Dyeing Association
H. W. Butterworth and Sons Company
Lowell Textile Institute

3. Pad Steam
Graniteville Company
N. C. State College
Providence Dyeing Bleaching & Calendering Company

C. Raw Stock

1. Kettle
Ciba Company, Inc. (5 pounds capy.)
Glenlyon Print Works (6 gallons capy.)
Lowell Textile Institute (10 pounds capy.)
N. C. State College (1, 5, 20 pounds capy.)
Phoenix Hosiery Company (5 pounds capy.)
Alexander Smith & Sons Carpet Co. (Smith-Drum, 50 pounds capy.)
William Whitman Company, Inc. (3 pounds capy.)

2. Miscellaneous
Clemson College (Chattanooga Vacum Type, 3 pounds capy.) Psarski, 10 pounds capy.)
Lowell Textile Institute (Hussong, 50 pounds capy. and Psarski, 15 pounds capy.)
Venango Engineering Company, Inc.

D. Wool Top
William Whitman Company, Inc. (two-spool Abbot, 50 pounds capy.)
Lowell Textile Institute (Psarski, 15 pounds capy.)

E. Yarn

1. Package
Aberfoyle Manufacturing Co. (Smith-Drum, 1 pound)
Bradford Durfee Technical Inst. (Smith-Drum, 1 pound, Franklin 1 pound, and Venango, 60 pounds)
Buffalo Electric Co. 1 pound capy.)
Cannon Mills Co. (Gaston County, 1 pound capy.)
N. C. State College (Gaston County, 1 and 25 pounds)
Ciba Company (Franklin, 1 pound)
Forstmann Woolen Company (Franklin, 1 pound)
Jacques Wolf and Company
Lowell Textile Institute, Franklin, 1 and 25 pounds)
National Aniline Division, Allied Chemical & Dye Corp. (Franklin, 1 pound capy, and Gaston County, 1 pound capy.)
Scholler Brothers, Inc., (Obermaier, 1 pound capy.)
Venango Engineering Co., Inc.
Wiscassett Mills Company, 1, 10 and 25 pounds capy.)
William Whitman Company, Inc. (1 pound capy.)

2. Skein
Clemson College (Smith-Drum, 10 pounds capy.)
Lowell Textile Institute (Klauder Weldon, 25 pounds capy.)
N.C. State College (Smith-Drum, 10 pounds capy.)
S. and M. Dye Works, Inc. (25 pounds & 50 pounds)
Scholler Brothers, Inc. (Smith-Drum, Cascade type)

II. FINISHING OF WET PROCESSING EQUIPMENT

A. Calenders
H. W. Butterworth & Sons Co. (3-Roll Lab. Friction—18" face)

B. Dryers
Buffalo Electro-Chemical Company (Warm air, batch, 40 cubic feet capy.)
H. W. Butterworth & Sons Co. (6-Cylinder, 36"; Laboratory Dryer 36" x 12" x 44")
Ciba Company, Inc. (1 pound Package Extractor — Obermaier-Steinen)
Cold Spring Bleachery (Proctor and Swartz)
Cranston Print Works Company
Forstmann Woolen Company
Harris Research Laboratories (Buflovak 8" drum; Laboratory oven 18" x 28" x 25", high air velocities)
Lowell Textile Institute
Providence Dyeing Bleaching & Calendering Co. (Gas fired curing oven)
Scholler Brothers, Inc. (Buflovak, double drum)

C. Folders
H. W. Butterworth & Sons (Dribbling—18" face, Plain—36" face)

D. J. Box
Buffalo Electro-Chemical Company (Becco, for continuous bleaching, 75 pounds capy.)

E. Kier
Clemson College (50 pounds capy.)

F. Padders
Joseph Bancroft and Sons Company
Bradford Dyeing Association
Burkart-Schier Chemical Company
H. W. Butterworth and Sons Company
Carbic Color and Chemical Company (9" face)
Ciba Company, Inc.
Cold Spring Bleachery
Cranston Print Works
Geigy Company, Inc.
Glenylon Print Works
Graniteville Company
Harris Research Laboratories
National Aniline Division, Allied Chemical & Dye Corp.
Nova Chemical Corporation
Pacific Mills
Providence Dyeing Bleaching & Calendering Co.
Sandoz Chemical Works, Inc.
Scholler Brothers, Inc.
Research Division, West Point Manufacturing Co.

G. Singe
H. W. Butterworth and Sons Company

H. Slasher, Laboratory
N. C. State College
Alexander Smith and Sons Carpet Company, Inc.

I. Tenter Frames
H. W. Butterworth & Sons Company (7' Straight—18")

J. Washers
H. W. Butterworth & Sons Co. (6-Roll Laboratory Horizontal —18" face)
Cold Spring Bleachery (Najort Standard model—24" x 20")

III. MANUFACTURING EQUIPMENT

A. Cotton or Synthetics)

1. Carding, Spinning, Weaving, etc.
Bradford Durfee Technical Institute
Continental Mills Ave.
A. French Textile School of the Georgia School of Technology.
N. C. State College

2. Knitting
A. French Textile School of the Georgia School of Technology.
N. C. State College
Scholler Brothers, Inc.

B. Wool

1. Carding, Spinning, Weaving, etc.
Collins & Aikman Corp.
Forstmann Woolen Company
Alexander Smith & Sons Carpet Co., Inc. (Small carpet looms)

IV. PRINTING EQUIPMENT

A. Agers and Steamers

Joseph Bancroft and Sons Company (Printing)
H. W. Butterworth and Sons Company (Laboratory, 18" face)
Carbic Color & Chemical Co. Laboratory, American Sterilizer Company)
Cranston Print Works
Lowell Textile Institute
National Aniline Division, Allied Chemical & Dye Corp.

B. Roller Machines

Joseph Bancroft and Sons Company
H. W. Butterworth & Sons Company (1 color, 18" face)
Carbic Color and Chemical Co (1 color, 9" face and 6 color, 9" face)
Clemson College (Mather-Platt Ltd. 10" width)
Geigy Company, Inc.
Glenlyon Print Works
Lowell Textile Institute
National Aniline Division, Allied Chemical & Dye Corp.
Nova Chemical Corp.
Pacific Mills
Waldrich Company

V. RESEARCH EQUIPMENT, SPECIAL

A. High Frequency Generators

Cannon Mills Company 2.5 KW. R.C.A.)

B. Spectrophotometers

N. C. State College (Beckman)
Procter & Gamble Chemical Division (Beckman and Perkin-Elmer, model 12C, Infra Red)

VI. TESTING EQUIPMENT

A. Accelerated Fading Units

Aberfoyle Manufacturing Company
Bradford Durfee Technical Institute
Bradford Dyeing Association
Celanese Corporation of America
Clemson College
Forstmann Woolen Company
Jacques Wolf and Company
Nova Chemical Company
Nyanza Color and Chemical Company
Phoenix Hosiery Company
Procter and Gamble Chemical Division
Rit Products Corporation
Wiscassett Mills Company

B. Gas Fading

Bradford Dyeing Association
Celanese Corporation of America

C. Launder-Ometer

Bradford Durfee Technical Institute
Bradford Dyeing Association
Burkart-Schier Chemical Company
Celanese Corporation of America
Clemson College
Forstmann Woolen Company
N. C. State College
Nova Chemical Corporation
Nyanza Color & Chemical Company
Phoenix Hosiery Company
Procter and Gamble Chemical Division
Providence Dyeing, Bleaching and Calendering Company
Wiscassett Mills

D. Miscellaneous Testing Apparatus

Bradford Dyeing Association
Burkart-Schier Chemical Company
Aberfoyle Manufacturing Company
Commonwealth Color and Chemical Company
Cooper, Wells and Company
Forstmann Woolen Company
Mock, Judson, Voehringer Company of North Carolina
Procter and Gamble Chemical Division
Providence Dyeing, Bleaching and Calendering Company
Nopco Chemical Company
Swift Manufacturing Company

E. Textile Testing Laboratory, Complete

Better Fabrics Testing Bureau, Inc.
N. Erlanger Blumgart and Company, Inc.
Bradford Durfee Technical Institute
Buffalo Electric Company
Celanese Corporation of America
A. Franch Textile School of the Georgia School of Technology

Six of the concerns listed above had such a large quantity of pilot plant equipment that it was deemed advisable to list the companies separately. These companies and their equipment follows:

General Dyestuff Corporation
435 Hudson Street
New York 14, New York

ITEM	*MANUFACTURER*
Ager—Acid-Stainless Steel	
Ager—Vat	
Autoclave—10 lb. pressure	
Centrifugal—1 lb.	American Tool & Machine Co.
Centrifugal—12 in. Stainless Steel	Fletcher
Copper Kettle—Steam Jacketed with Mechanical Paddle—100 lb.	
Copper Kettle—Steam Jacketed—3 gal.	
Dye Reel for Piece Goods, Enclosed—Stainless Steel —10 gal.	Hunter
Fadeometers—FDA	Atlas
Fadeometers—FDA-R	Atlas
Gas Fading Chamber	U. S. Testing
Homo-mixers—Laboratory Type No. 1	Eppenbach
Hurricane Dryer	Proctor and Schwartz
Jig—Stainless Steel	Butterworth
Launderometers with Preheating Table	Atlas
Launderometers—No Tables	Atlas
Package Dyeing Machine—1 lb. Bronze	Franklin
Package Dyeing Machine—1 lb. Iron	Franklin
Package Dyeing Machines—1 lb. Stainless Steel	Smith-Drum
Padder—2 Roll	Butterworth
Padder—3 Roll	Butterworth
Padder—2 Roll	Gregg
Pad making Machine	Abbott
Printing Machine—2 Color—Variable Drive 1 to 13½ yds. per min.	
Printing Machine—1 Color	
Reflection Meters—Model 610	Photovolt Corp.
Skein Dyeing Machine—Single Tube Monel Metal	Smith-Drum
Slub Dyeing Kettle—Aluminum 1 lb.	Abbott
Three Roller Mill—4" x 8"	Kent
Washer—Cylinder Type—Reversing Cycle	Thor
Washer—Automatic	Thor
Weatherometer—Twin Arc.—DLTS	Atlas
Williams Unit—Stainless Steel	
Daylight Lamps	Macbeth

American Viscose Corporation
Marcus Hook, Pennsylvania

ITEM	*MANUFACTURER*
Beamer	Van Vlaanderen
Hosiery dryer	Proctor and Schwartz
Hosiery dryer	Paramount
Padder	Van Vlaanderen
Centrifugal extractor	Tolhurst
Silk Calender, 3 roll	Van Vlaanderen
Decatizer	Van Vlaanderen
Palmer	Van Vlaanderen
Suction drum dryer	Proctor and Schwartz
Tubular Calender	Grand Rapids
Cabinet dryer	Proctor and Schwartz
Tenter frame	Van Vlaanderen
Overhead plaiter	American Viscose Corp.
Dye Box	American Viscose Corp.
Steam jacketed kettle	
Pressure dyer	Smith-Drum
Hosiery dyer	Smith-Drum
Three arm skein dyer	Smith-Drum
One arm skein dyer	Smith-Drum
Sample cake dyer	American Viscose Corp.
Crab	Curtis and Marble
Jig	Van Vlaanderen
Tensionless jig	
Deep dye kettle	Butterworth
Washer	
Fulling mill	Riggs and Lombard
18" beck	Van Vlaanderen
4' beck	Van Vlaanderen
4' beck	James Hunter
Decatizer	David Gessner
Raw Stock dryer	Proctor and Schwartz
Overfeed pin tenter	Proctor and Schwartz
Steam press	David Gessner
Special package dryer	Smith-Drum
Tacking machine	Birch Bros.
Button breaker	
Singer	Carbomatic
Steam brush	Parks and Woolson
Napper	Woonsocket
Shear	Curtis and Marble

United States Department of Agriculture
Southern Regional Research Laboratory
2100 Robert E. Lee Blvd.
New Orleans 19, Louisiana

Cotton Processing Division

1. One cotton bale press for repackaging cotton and cotton waste.
2. Opening and Picking Room:
   a. This room has been provided with standard Whitin opening and picking room equipment, namely, Automatic Feeder, Spirawhirl Beater, Downstroke, Cleaner, Condenser, a combination Breaker and Finisher Picker, and three Return Air Condenser Units. Average capacity for this line of equipment is approximately 350 pounds per hour.
   b. Shirley Analyzer.
3. Carding Room:
   a. A fine card having the cylinder, flats, and doffer covered with 110's clothing, and a coarse card having its cylinders covered with 90's clothing and the doffer and flats covered with 100's clothing were provided. Provision has been made for varying production, carding speeds, lickerin and flat speeds, and waste percentage control. The productive capacity of each card ranges from approximately 4 to 18 pounds per hour—depending, of course, on the doffer speed and sliver weight per yard. Made by Whitin.
   b. Two cards same as 110's clothing above (Saco-Lowell).
   c. One roller top card, Saco-Lowell.
   d. A conventional Whitin 4-roll common top roll drawing frame having a draft range from 4-8, doublings from 4-8, a sliver weight range from 40-80 grains, 4 deliveries, and an average production high enough to balance the cards is used to process all the card sliver.
   e. One drawing frame same as above but made by Saco-Lowell.
   f. Medley drawing frame, single delivery.
   g. Saco-Lowell Sliver Tester. H & B Belger Roving Tester Grain Scales.
   h. In order to realize a hank roving range from .5 to 12 it was necessary to install 3 classes of fly frames. The first is a 10 x 5 Whitin Inter Draft fly frame having a draft range from 3.6—22, twist range from .37—3.33, and hank roving range from .4—2.00 and its production varies from .5 to 1.5 pounds per spindle per hour according to hank roving processed. This frame has 48 spindles.
   i. The second is an 8 x 4 Whitin Super-Draft fly frame having a draft range from 3.6—72, twist range from .90—4.75, and hank roving range from 2.00—6.00. This frame has 64 spindles with an approximate production from .1 to .5 pounds per spindle per hour.
   j. The third is a 7 x 3 Whitin Intermediate fly frame equipped with a 3-roll standard draft system and capable of making a hank roving from 4 to 12.
   k. The fourth is a 64 spindles 8 x 4 Saco-Lowell four roll High-Draft fly frame having a draft range from 10-50, twist range from 1.5 to 10, and hank roving range from 1.5 to 6.
4. Spinning Room:
   a. Spinning Frames
      (1) One 5" gauge, 56 spindles Casablanca control draft frame, counts 3s to 17s (Whitin) 20s .0702 3½ lbs./hr.
      (2) One 4¼" gauge, 64 spindle Casablanca control draft frame. Counts 13s to 36s (Whitin) 30s .0514 3 lbs./hr.
      (3) One 4¼" gauge, 216 spindle Casablanca control draft frame. Counts 13s to 36s (Whitin) 10 lbs./hr.
      (4) One 3½" gauge, 72 spindle Casablanca control draft frame. Counts 25s to 120s.
      (5) One 3½" gauge, 72 spindle Long Draft frame. Counts 25s to 120s (Saco-Lowell).

All five spinning frames are equipped with variable speed drives and yardage counters.

b. Twisting Frames
   (1) One 4½" gauge, 60 spindle frame, equipped for twisting 2-8 ends of 16s to 100s yarns (Whitin).
   (2) One 5½" gauge, 40 spindle frame equipped for twisting 2-16 ends of 2s to 165s yarns. (Whitin).
   (3) One 6½" gauge, 32 spindle frame equipped for twisting 2-16 ends of 2s to 16s yarns. (H&B).

   All three twisters are equipped with variable speed drives, yardage counters, and vertical and horizontal rings of different sizes.

5. Winding Equipment:
   a. One 12-spindle multiple purpose winder. 6 spindles for doublings 2-6 ends on tubes; 4 spindles for winding on cones, 2 spindles for winding from swifts. Also 2 spindles which are interchangeable for winding on package for dyeing by Franklin Process. (Universal).
   b. One 12-spindle multiple purpose winder—all spindles for doubling on tube. (Universal).
   c. One heavy duty Foster Winder. 5 spindles for winding tubes and 5 spindles for winding cones.
6. Stretching Device for Cord (Foster Winder):
   Two specially designed tire cord stretching units.
7. Ply Building Machine:
   48" x 48" drum and equipped with device for laying cord on drum within a range of 6-60 ends per inch in increments of about two ends per inch. Range of speed for laying the cord is 60 to 150 feet per minute, capacity with low gauge cord (.024) 30 ends per inch, 140 ft. per minute is approximately hours for laying and rolling 36" width ply.
8. High-frequency Dieelectric Heating:
   One commercial unit with 1 k w output.
   One laboratory constructed unit with 100—1,400 watts output.
9. Looms:
   1—42" Draper Mod X-P with Dobby or Cams (Crompton & Knowles)
   1—60" Draper Mod X-P Cams, 2 to 5 sheds (Crompton & Knowles).
   2—14" Draper Mod E (closed in by Hunt Machine Works, Greenville, S. C.) (Crompton & Knowles).
   1—48" Automatic Box Loom (4 x 1) (Crompton & Knowles).

Cotton Chemical Finishing Division

ITEM	*MANUFACTURER*
Padder, Laboratory (20" face)	H. W. Butterworth and Sons
Dye Jig, Laboratory (20" face)	H. W. Butterworth and Sons
Dryer, Skein	Proctor and Schwartz
Patch steamer	The Textile Finishing Machinery Co.
Yarn Dyeing Machine, 6 package	Gaston County Machine Co.
Winder, Universal No. 50, Single Spindle	Universal Winding Company
Winder, Universal No. 50, Six Spindle	Universal Winding Company
Kier, 200 lbs. Capacity	William Allen Sons Company
Dye Winch, 18 inches	Rodney Hunt Machine Co.
Dye Winch, 36 inches	S. R.R.L. Machine Shop
Centrifugal Extractor, 30"	American Machine and Metals, Inc.
Dye Jig, 50 inch beams	H. W. Butterworth and Sons
Padder, two rolls, 50 inch rolls	H. W. Butterworth and Sons
Steam heated drying cylinders, 11 can set, 50 inch face	Morrison Machine Co.
30 Foot Tenter Frame, 50" capy	Morrison Machine Co.
Calender, Three Roll, 50"	Textile Finishing Machinery Co.
Two Sewing Machines, High-Speed	The Merrow Machine Co.
Sewing Machine, Rotary	Birch Brothers
Sewing Machine, Heavy Duty	The Singer Manufacturing Co.

Calco Chemical Division, American Cyanamid Co.
Bound Brook, New Jersey

ITEM	*MANUFACTURER*
1—10 Color Ribbon Print Machine	Van Vlaanderen Machine Co.
2—Hand Operated Printing Machines	U. S. Finishing Co.
1—Continuous Dyeing Machine (on order)	Rodney Hunt Machine Co.
2—Dye Kettles	J. Hunter Machine Co.
4—Package Dyeing Machines	Smith Drum Company
1—Piece Goods Reeling Machine	Calco Chemical Division
1—Sample Carding Machine	Davis & Furber Machine Co.
1—Experimental Winder	Sipp-Eastwood Company
1—Skein Reeling Machine	Fidelity Machine Co.
1—Single Tube Skein Dyeing Machine	Butterworth Co.
1—3-Roll Padder with V-Box	Butterworth Co. and Calco
1—20 Spindle Roto-Coner	Universal Winding Co.
1—5-Feed Plain Knitting Machine	Hemphill Co.
1—Tower Type Acid Ager	Haveg Co. and Calco
1—Dolly Washer	J. Hunter Machine Co.
3—Najort Test Washers	R. Ewing and Sons, Inc.
1—Special Hydewa Impregnator	L. J. Barret and Co.
1—24" Dia. Basket Extractor	Troy Laundry Co.
1—Cabinet Dryer 31 3/4" x 31" x 54"	R. D. Kenyon
1—Pin Type Tenter—30" wide fabric—1-6 Y.P.M.	R. D. Kenyon
1—Steam Presser Size 24/ x 60"	Hoffman Co.
1—Calender	Butterworth Co.
1—Cloth Winding and Measuring Board Model GA —Size 64"	Hermas Machine Co.
Miscellaneous Dryers, ovens and padders	

E. I. du Pont de Nemours and Company
Wilmington 98, Delaware

1. Pad Steam Continuous Dyeing Machine and dryer. For piece-goods, 8" width. Stainless steel.
2. Multi-Lap Continuous Processing Machine. For piecegoods, 8" width. Stainless Steel.
3. Several two and three roll laboratory padders. H. W. Butterworth and Sons.
4. Automatic yarn dyeing machine. 12 boxes. Rotating arms each capable of handling up to 2 lbs. of cotton at a volume of 20:1.
5. Jig. Stainless steel. 12 inch roll.
6. Jig. Monel metal, 40 inch roll.
7. Jig. Iron, 8 inch roll.

8. Covered jig. Stainless steel. 6 inch roll.
9. Reel dyeing machine. Stainless steel. 5 to 10 yds. capy.
10. Two wooden reel machines. 12 to 20 yards capy.
11. Three Franklin package dyeing machines. Iron. One lb.
12. One Gaston package dyeing machine. Stainless steel. 1 lb. capy.
13. One Smith-Drum package dyeing machine. Stainless steel. 1 lb. capy.
14. Chattanooga Rawstock Dyeing Machine. Iron, 5 lbs. capy.
15. Two printing machines. One-color rolls, 18 inches long.
16. Two printing machines. One-color rolls, 6 inches long.
17. One rapid ager. Blanket conveyor. About 18 inches wide, variable speed.
18. One acid ager. Haveg. Blanket conveyor, continuous, 18 inches wide, operated as a batch steamer.
19. One Schnelldampfer for steaming rolled cloth. 18 inches wide.
20. One small cottage steamer.
21. One stack can dryer. 5 cans. 5 feet

Rhode Island School of Design
Providence 3, Rhode Island

a. General Chemical Laboratory
b. Semi-Micro Qualitative Analysis Laboratory
c. Quantitative Analysis Laboratory
d. Organic Chemistry Laboratory
e. Dye Laboratory
f. Microscopic Laboratory*
g. Textile Testing-Conditioned Room*
h. Physical Chemistry Laboratory—Ready by September, 1949
i. Physics Laboratory
j. Textile Chemical Laboratory*
k. Textile Manufacturing

* See itemized equipment list below.

Can make pilot plants run of yarn and cloth of

1. Cotton fibers
2. Wool fibers
3. Worsted fibers
4. Filament Synthetic fibers
5. Spun Synthetic fibers
6. Blends of all types—Ready 1949
7. Unions of all types

Equipment List

e.* Dye Laboratory
1. Raw stock dyeing unit
2. Smith Drum Skein dyeing unit
3. Raw stock dryer
4. Other equipment expected to be added

f.* Microscopic Laboratory
1. Auxiliary Equipment for examination and measuring fibers, yarn, cloth, micro-projector. Photomicrosgraphy room expected to be ready 1949 or 1950.

g.* Conditioned Room—Textile Testing
1. Emerson Conditioning Oven
2. Scott Pendulum Breaking Strength
3. Scott Inclined Plane Yarn Tester
4. Scott Automatic Twist Tester
5. Twist Tester
6. Suter Yarn Tester
7. Equipment for testing yarn, fibers, and cloth
8. Additional Equipment expected to be added before Sept. 1949

j.* Textile Chemistry
1. pH Meter
2. Photometer
3. Launder-o-meter
4. Fadeometer
5. Crockmeter

The following companies have available pilot plant equipment for use in development in textile chemical specialties and are willing to cooperate with the A.A.T.C.C.

Alrose Chemical Co.
P. O. Box 1294
Providence 1, R. I.
H. W. Zussman, Vice Pres.

Nopco Chemical Co.
First & Essex Sts.
Harrison, New Jersey
Dr. E. A. Robinson, Asst. Vice Pres.

Sayles Finishing Plants, Inc. &
Sayles Biltmore Bleacheries, Inc.
Saylesville, R. I. & Biltmore, N. C.

U. S. Department of Agriculture
Western Regional Research Lab.
800 Buchannan St.
Albany 6, California
M. J. Copley, Dir.

Warwick Chemical Co.
Div. Sun Chemical Corp.
100 Pulaski St.
West Warwick, Rhode Island
R. A. Pingree, Chemical Dir.

Arnold, Hoffman & Co., Inc.
55 Canal St.
Providence 1, R. I.
E. D. McLeod, Asst. to the Pres.

Pioneer Salt Co.
940 North Delaware Ave.
Philadelphia, Pennsylvania
W. L. Baumner, Jr., Sales Mgr.

U. S. Department of Agriculture
Northern Regional Research Lab.
Peoria 5, Illinois
R. T. Milner, Dir.

Verney Corp.
1412 Broadway
New York 18, New York
A. J. Huber, Dir. of Fabric
Development and Research Div.

In making use of the above information it is suggested that the type of pilot plant equipment desired be selected from the alphabetized listing. Under the equipment concerned will be found the names of the organizations having such equipment. The complete address of the company and the name of the person to be contacted in connection with the use of pliot plant equipment may then be found under the alphabetized list of companies having equipment.

CALENDAR

NATIONAL CONVENTIONS

1950: September 28 to 30, Portsmouth, N. H.
1951: October 18 to 20, Statler, New York
1952: Boston.

MID-WEST SECTION

Meetings: Feb. 18 (Bismarck Hotel, Chicago), May 6 (Schroeder Hotel, Milwaukee, Wisc.).

NEW YORK SECTION

Meetings: Mar. 3 (Hotel Statler, New York), April 14, May 5 (Kohler's Swiss Chalet, Rochelle Park, N. J.), June 16—Outing.

NORTHERN NEW ENGLAND SECTION

Meeting: Jan. 27, (Hotel Vendome, Boston).

PHILADELPHIA SECTION

Meetings: February 24, March 31, May 5 (Kugler's, Philadelphia), June 9 (Annual Outing), October 13, December 8, January 17, 1951.

PHILADELPHIA TEXTILE INSTITUTE STUDENT CHAPTER

Meetings: February 1, March 1, March 29, April 26, and May 24.

PIEDMONT SECTION

Meetings: April 1 (Robert E. Lee Hotel, Winston-Salem, N. C.), June 30-July 1 (Ocean Forest Hotel, Myrtle Beach, S. C.).

SOUTH CENTRAL SECTION

Meeting: February 18, (Hotel Patten, Chattanooga, Tenn.)

WESTERN NEW ENGLAND SECTION

Meetings: January 27 (Rapp's Restaurant, Shelton, Conn.), March 10 (Waterbury, Conn.), April 14 (Rapp's Restaurant, Shelton, Conn.) May 26 (Waverly Inn, Cheshire, Conn.) June 23 (Outing at Wallingford, Conn. Country Club).

Rhode Island Section—

FIBERGLAS IN INDUSTRY*

J. K. PARK

Mgr. Textile Research & Development, Owens-Corning Fiberglas Corp.

Introduction

IT is indeed a privilege to be invited to present the story of Fiberglas before this fine audience. While I realize that the majority of my listeners are technically trained, I somehow have the conviction that they will carry away a more complete understanding of the glass fiber industry and of the properties and uses of Fiberglas products if I minimize the purely technical aspects of the business and give more attention to the history of the development and the inherent properties and uses of the fibers.

An important point I would like to emphasize is the great versatility in use of glass fibers. There is hardly an industry or a process where the properties of glass fibers do not lend valuable assistance. This fact probably poses our greatest problem in the assignment of research projects—not what can be developed, but which of many lines of endeavor is the most promising. As I proceed with this discussion, see if you don't agree that for a comparatively new product its versatility is unique.

Coarse, nonuniform, brittle glass filaments have been produced since very early times. We know this because specimens have been found in the tombs of the early Egyptians and in the ruins of Pompeii. From that time until 1900 very little was done, but in the early 1900's a number of patents were issued in Germany, and some in England, on various processes for drawing glass fibers.

The modern day story of Fiberglas begins in 1931 when the possibility of manufacturing glass fibers was first seriously explored in the United States.

The major tasks were to make glass fibers much finer than had ever been done before, make them much faster and, of course, much cheaper.

To do this, the original laboratory setup was a specially designed oxyacetylene burner through which a glass rod could be fed, so that the effect of the combustion gases was to draw out molten filaments of glass.

The first large-scale attempts, still on the pilot plant scale, used a trough-shaped refractory container for molten glass, the bottom of which was drilled on half-inch centers from which streams of molten glass emerged into an enveloping jet of high-velocity steam. The setup worked as far as the process was concerned, but it was not practical on several counts. The fine holes in the refractory rapidly eroded to larger ones. Theg temperature of the glass (and hence its viscosity) could not be held constant, so a non-uniform product was produced. Following the struggles with a variety of refractories, a trough of precious metal alloy was tried. This was immediately successful because we could maintain a constant temperature and a constant hole size for molten glass to flow through. This was the basic invention, not only for making insulating wool, but later for making textile fiber.

From that time until the present, the history of Fiberglas development is shown by the products displayed on these panels.

Development of glass formulae that would meet the special requirements for glass in fiber form was of basic importance. A pound of glass fibers with average diameters of 5 one-hundred thousandths of an inch has 30,000 times the surface area of the same amount of glass in the form of a sphere. The greater the surface area, the greater is the opportunity for surface attacks to occur; this is the reason why special glass formulae had to be developed to give the fine glass fibers resistance to weathering and chemical corrosion.

Properties

All types of glass fibers possess certain properties in common that are basically responsible for the wide range of services they are able to perform. Let me examine some of them:

First, flexibility is the property of glass fibers which distinguishes them from all other forms of glass, and which everyone can feel and see. Fibers of glass are flexible for just one reason. They are almost incredibly thin in relation to their length. Their diameter must be only a few hundred thousandths of an inch.

Second, fibers of glass are incredibly strong. The tensile strength of bulk glass is 10,000 pounds per square inch. Glass fibers averaging 23 one-hundred thousandths of an inch in diameter have a tensile strength of more than 400,000 pounds per square inch.

Third, cast aluminum, bulk glass and glass and glass fibers all have about the same specific gravity, approximating 2.5. However, a cubic foot of uncompressed glass fibers weighs only one and a half pounds, and is approximately 100 times lighter than a cubic foot of bulk glass.

Fourth, the strength-weight ratio of glass fibers is extremely high, the greatest of any commercial material occurring in nature or synthesized by man. If we compare glass fibers, stainless steel and aluminum, and if we divide the tensile strength of each by its specific gravity, we find that the specific strength (strength per unit weight) of the glass fibers is 104,200 as compared with 32,400 for stainless steel and 15,375 for aluminum.

Fifth, glass fibers are truly elastic. They exhibit reversible elasticity up to 3 to 4 per cent elongation. (The elasticity of steel is reversible only up to 0.2 per cent elongation.)

Sixth, they do not absorb moisture. Although they may be as fine as gossamer, the fibers are actually microscopically thin glass rods. Because they have no cellular inter-structure, they cannot absorb moisture. Their surfaces can be wet, but moisture cannot enter the fibers themselves.

Seventh, glass fibers are dimensionally stable. Since they do not absorb moisture

* Presented before the Rhode Island Section, October 28, 1949.

they will not shrink, stretch or swell. Because of their high tensile strength and perfect elasticity, they resist distortion. They also possess a very low coefficient of thermal expansion (2.8 x 10^{-6}/deg. F.), and are little affected by changes in temperature.

Eighth, they are chemically stable, being unaffected by most acids, salt solutions and weak alkalies. The few exceptions are hydrofluoric acid, hot phosphoric, acid solutions of fluoride salts and strong alkalies.

Ninth, they cannot oxidize, for the chemical elements which constitute the glass are already in a complete state of oxidation. This is the main reason why the tiny filaments are stable in our atmosphere, they cannot oxidize, rust or rot.

Tenth, the fibers are completely *noncombustible.* Light a match to a strand or clump of the glass fibers and they will not flame up or even smolder. They may sinter or melt, but they cannot burn.

Fiberglas Products

In many of their applications, Fiberglas materials are combined with, or concealed by, some other material. As a consequence, many people have only a vague notion of what Fiberglas materials really are. Even those people who buy and use Fiberglas materials often think of them solely in terms of the particular substance with which they are familiar, and are unable to visualize Fiberglas in its many other forms. Now we have developed five basic forms of Fiberglas: filters and aeration packs, wool, textiles, mats, and the newest form, Aerocor, and there are many times that number of fabricated materials. No one of our basic forms bears any superficial resemblance to any of the others, and the fabricated materials differ widely in appearance, so the confusion that sometimes exists in the minds of our friends is understandable.

The panels I would like to show you now each contain materials made of one of the five basic forms, and illustrate some of their principal applications.

. . . (PANEL #1): On this panel was shown a replaceable air filter and an aeration pack, both of which illustrated applications of relatively coarse glass fibers fabricated into pads to provide a very large total surface area. . .

Air filters are standard equipment for forced warm-air heating systems, ventilating systems and air conditioning systems, in homes, factories, stores, theatres, and other buildings.

Aeration packs are used by the process industries for filtration of gases, liquids and sludges, and in evaporation, diffusion and fractionation applications. They are also used in all types of air conditioning systems where water is employed for cooling, humidity control or air washing.

. . . (PANEL #2): Here were shown four materials, all fabricated from Fiberglas in the basic wool form and used for thermal and acoustical insulation. . . .

The resilient, intricately interlaced glass fibers which are the basis of all Fiberglas thermal and acoustical insulation materials are fabricated into batts and boards for the insulation of household appliances, and into blankets for the insulation of homes. Predetermined density of the boards can range from 2 to 10½ pounds per cubic foot.

The fibers are also fabricated in the form of blowing wool. This material and service is now available for home insulation on a nation-wide basis, through approved applicators.

The thermal conductivity at 50 degrees mean temperature difference ranges from .28 for the batts and blankets at a normal density of one and a half pounds per cubic foot, to .22 for a 10½ pound density board. This very low thermal conductivity is due primarily to the millions of air spaces entrapped by the interlaced fibers. These air spaces are poor conductors of heat. In addition, where the fibers cross and touch each other, they have exceedingly small contact points. Heat, therefore, cannot pass readily from one fiber to another.

The amount of moisture picked up by the massed fibers from humid air is infinitesimal, not more than .5 per cent by weight in high humidity atmosphere. The rapidity with which Fiberglas insulation will dry out after wetting, if drained and vented to the air, is due to the fact that water can wet only the surfaces of the fibers.

. . . (PANEL #3): This showed the same basic wool form, fabricated into molded pipe covering, into coated duct insulation, and into boards and blankets used for the thermal or acoustical insulation of industrial buildings or equipment. . . .

Fiberglas boards accurately molded into cylindrical shape provide a convenient and efficient material for insulating steam and other pipes in all standard sizes up to 30 inches, and for temperatures up to 800°F. A blanket-type insulation with metal-mesh facing is employed for insulating pipes, stills, etc., up to 1000°F. These metal mesh blankets are also employed for the insulation of heated equipment such as boilers, tanks, industrial ovens, dryers and large ducts.

For warm air heating, and air conditioning applications, "coated duct" is used. This material is covered with a fireproof coating to reduce porosity, serve as a base for painting, and to improve acoustical and thermal properties.

Fiberglas boards are used in the fabrication of roof insulation and of shipboard hull and bulkhead insulation. They are also employed in all types of low and medium-temperature equipment from the temperature of liquid oxygen up to about 800°F.

A recent development is a line of light-weight, high-temperature insulating materials which will withstand temperatures up to 1800°F. Composed of specially processed filaments of glass, the new line is designed for industrial, marine and aircraft applications which require a flexible removable type of insulation. The greatest use for this material is to insulate jet engine tail pipes for aircraft.

There is also a Fiberglas insulating cement which can be used over insulating blocks and blankets to provide a monolithic insulation for pipes, tanks, ovens and other types of heated equipment.

Sheathed on all sides with a tough, durable asphalt coating, Fiberglas AE board is widely used in cold storage service, and performs efficiently under conditions of moisture and temperature variations such as exist in refrigerated spaces. Asphalt-enclosed board can be used for the insulation of load bearing floors and the construction of self-supporting, but not load-bearing, partitions.

The fact that glass fibers are completely non-combustible enables these insulating materials to serve as an effective fire barrier in many of their applications. An interesting example is the case of twenty-nine hundred dressed turkeys, valued at nearly $35,000, which were in the main refrigeration unit at a California turkey ranch when fire destroyed the processing plant. The turkeys, instead of being cooked to a cinder, were in perfect condition when the fire burned itself out, and only a small outer layer of Fiberglas insulation was disturbed by the fire.

The same basic material that is used for thermal insulation is used to absorb air-borne sound waves.

Fabricated into boards and tile, it provides a low-cost, lightweight non-combustible ceiling material, either plain or perforated, with high sound-absorbing properties. It can be cemented to a solid backing or mechanically mounted on wood or metal furring strips.

In some applications the same material serves for both thermal insulation and sound absorption.

. . . (PANEL #4). This panel showed battery retainer mats. . .

These are thin, felted mats of glass fibers, employed by practically all storage battery manufacturers to give longer life and greater stamina to their batteries used in automotive vehicles. The mats minimize the shedding of active material from the positive plate.

Another very large use for the mats which we call Coromat is in the protection of underground pipe lines in the petroleum and other industries. Damage caused by electrolytic corrosion is one of the largest items of expense in maintaining such lines.

To provide this protection, the pipe is insulated very much as a wire conducting electricity is insulated. A hot, fluid coating material such as tar, that hardens as it cools, is applied; then while the coating is still fluid, the pipe is wrapped with Coromat and the coating material quickly saturates this porous mat.

Used alone, coating materials have little structural strength and could easily be broken from the pipe.

. . . (PANEL #5): This panel showed a blanket of Aerocor. . . .

There is another form which is rapidly assuming major importance. I refer to Fiberglas superfine fibers which we call *Aerocor.* On this panel is a blanket composed of superfine fibers, which have average diameters of less than 9 one-hundred thousandths of an inch, as contrasted with standard glass fibers ranging from 22 to 38 one-hundred-thousandths of an inch.

Originally the principal use and still a large use of these superfine fibers was in acoustical and thermal blankets in aircraft. Before Fiberglas thermal insulation materials were produced, the lightest insulating materials weighed about 6 pounds per cubic foot. Fiberglas thermal insulating wool, at natural density. weighs one and one-half pounds per cubic foot, but superfine weighs only 5 tenths of a pound per cubic foot. The extremely light weight of the superfine materials, their noncombustibility, and the fact that they pick up a minimum amount of moisture from the air, make them standard materials for the thermal-acoustical treatment of aircraft of all types. Aerocor is widely used in the automotive industry for thermal and acoustical insulation for steel tops, hoods and dashboards.

Fiberglas superfine batts are used to insulate tobacco barns, to insulate ducts, and to provide warm interlinings for cold weather clothing such as ski jackets and sports coats. They are also widely used as insulation in a variety of household appliances and household accessories such as shopping bags for carrying frozen foods, ice buckets and ice-cube bowls.

. . . (PANEL #6): This showed Fiberglas filaments, continuous and staple, the basic form of all Fiberglas textiles. . .

On this panel you see a forming tube wound with a strand of 204 continuous glass filaments, each with a diameter of 23 one-hundred thousandths of an inch. Below it is a tube of Fiberglas yarn consisting of several twisted and plied strands. Below the tube of white yarn is a tube of dyed Fiberglas yarn covered by a transparent plastic film. Over on the right is a tube of Fiberglas cord used in electrical applications. Below it is a mat consisting of glass yarns bonded with a resin, which is used for reinforcing plastics. The panel is covered with a fabric woven of Fiberglas yarn.

Noncombustibility, dimensional stability and complete resistance to rot are rare properties in textiles. It is the possession of these properties that is largely responsible for the numerous current uses of Fiberglas textiles, and for the interest the textile industry is showing in exploring additional uses.

Staple fibers average about 9 inches in length. Length of the continuous filament fibers is limited only by packaging requirements. The filaments could be drawn to indefinite lengths, running to thousands of miles. The fibers are sturdy and can be twisted, plied and woven on standard textile machinery, adapted by only minor modifications to handle glass fibers.

The earliest use of Fiberglas textiles was as a base for electrical insulation. Organic-base insulation materials tend to disintegrate under heat, moisture, and corrosive chemicals. Impregnated with a suitable varnish or resin, glass insulations are highly resistant to all these conditions.

In original equipment and in rewinds, Fiberglas-base electrical insulation materials give motors, generators, transformers, and other electrical units greatly increased stamina, enabling them to operate under overloads and adverse conditions that quickly break down organic insulation materials.

A newly developed finishing process, Coronizing, imparts unexpected and remarkable properties to decorative glass textiles. Coronized fabrics exhibit a luster, and possess a "hand" which is unique in the curtain and drapery field. The process is permanent, and contributes to the serviceability, life and attractiveness of the fabric. Indeed, hotel managers report that Coronized marquisette curtains withstand many more trips to the laundry than do curtains made of conventional materials. They are fireproof, and do not shrink or stretch.

Our newest development in the field of decorative fabrics is dyeing and printing. Inability to color glass fabrics has long been a serious detriment to our entry into the decorative field. However, due primarily to the efforts of two of your members, Messrs. Caroselli and Gagnon, and with splendid assistance from many of you here, it is now possible to dye or print glass fabrics commercially in any color. These resulting fabrics possess excellent hand and drape, are light-fast in excess of 100 hours in the Fade-o-meter, can be washed or dry cleaned, and what is quite important to the housewife, do not require ironing—just wash and hang. One of these prints has been washed 20 times in a Bendix.

Development of processes for coating fabrics with vinyl resin opens up additional fields of use for Fiberglas textiles. Awnings and canopies, upholstery and auto tops are natural applications for vinyl coated fabrics.

The high-strength-weight ratio of individual glass fibers has always presented a challenge to develop materials in which this property could be utilized to full advantage. The challenge was met during the war by the development of Fiberglas reinforced, low-pressure plastic laminates. Glass fibers are employed to reinforce plastics much as steel rods are employed to reinforce concrete. Glass reinforced plastics are just beginning to emerge as a new industry, as a wonderful new structural material which can compete with steel and wood in many applications with impact resistance five times that of any other material.

These laminates possess extraordinary strength in relation to weight. I could quote figures, but if you will watch what this man with a sledge hammer is going to do you will get a more vivid impression than figures could give you.

. . . At this point a demonstration was given in which three panels—one of aluminum, one of steel, and one of Fiberglas-reinforced laminate— all of the same weight, were subjected to sledge hammer blows. . . .

That, perhaps, gives you an idea why a Fiberglas-reinforced plastic laminate was used as body armor during the war to protect soldiers from shrapnel and flying pieces of metal.

Because the low-pressure resins used in combination with glass reinforcements polymerize without giving off volatiles, it is possible to cure the laminates in any desired shape merely by holding them in contact with the mold. This makes it possible for fabricators to produce very large parts (the hull of a boat, for instance) without the expense and physical limitations imposed in use of high-pressure presses. The Navy now has a 28-foot personnel boat, the hull of which is made in one piece from Fiberglas reinforced plastic.

Credit for a recent major development in Fiberglas reinforced plastics belongs to an appliance manufacturer. This section of a spinner type washing machine tub and some 15 other parts are in production in his plant. Invariably, he re-

ports, costs are about 50% that of metal, and tooling costs average around 20% of what it would cost to fabricate in metal. Incidentally this tube out-performs either aluminum or porcelain enameled steel.

Before leaving the general subject of Fiberglas reinforcement, mention should be made of the rapidly growing use of Fiberglas textile yarns and cords for reinforcing paper in cases where very high strengths and very high tear resistance are demanded.

You have seen displayed here some of the most important applications of Fiberglas products as they exist today. We have under development many new applications for these five basic forms, and we hope they will lead to markets larger than those already established. As you review the various fields of application that have been discussed, automotive, industrial of all types, transportation, electrical, textile, marine, aircraft, air conditioning, refrigeration, building in many of its phases and plastics, I hope you will agree with my statement at the beginning of this talk. That is, glass in fiber form is an unusually versatile material. I hope too, that you will have gained some useful and interesting information with respect to its applications and properties.

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Wetting Agents—

(Concluded from Page P45)

Summary

A woven tape modification of the Draves wetting test has been compared with the standard skein tests. The tape method has many advantages in speed, convenience and reproducibility.

The results of a series of tests with varying hook weights, concentrations and temperatures is described, and a buoyancy-balance technique has been employed to correlate the effects of varying hook weights with the rate of wetting.

The reversal in apparent effectiveness of wetting agent concentrations with completeness of wetting has been confirmed for skeins, but no such effect was found with tapes or canvas strips. Lack of agitation during air displacement is suggested as a possible contributing factor.

Rewetting tests by the tape method are described, and have the advantages that both sinking tests and specular reflection tests can be employed on the same fabric.

NOTE:—Many commercial wetting agents have been employed and identified for the benefit of future workers in this field. No endorsement or condemnation of any specific product is implied or should be inferred from the data, since these tests are under specific conditions not generally encountered in plant practice, and no allowance is made for concentration or price. To evaluate a wetting agent for plant use, the test must be designed so that all conditions of temperature, concentration, hardness, electrolyte content, etc., are identical with those used in the plant. Even the type of agitation or pressure may make practical runs come out differently from laboratory tests.

Acknowledgment

The writer wishes to acknowledge the assistance of those who have pioneered in establishing the Draves test and the woven tape modifications (particularly, in the latter case, the Ciba Laboratories and Housatonic Dyeing & Printing Co.). He is indebted also to the past and present members of Synthron Laboratory staff, especially Leon Tigler who laid the groundwork for the test method, and Mrs. Gertrude Lacoste who has carried out much of the experimental work. The author thanks Synthron, Inc. for permitting the diversion of a considerable amount of laboratory time from commercial development to the theoretical research required for this paper.

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EMPLOYMENT REGISTER

This column is open for two insertions per year, per member, without charge. Blanks can be obtained from, and filed with, the Secretary of the Association Lowell Textile Institute, Lowell, Mass It is understood that these will be open to inspection by prospective employers who can obtain further information from the Secretary.

50-1

Education: M.S., Textile Institute.

Experience: One year in cotton finishing research laboratory.

Age 29; married; references; research or production in New England preferred.

1-23, 2-6

Investigations—

(Concluded from Page P50)

much more, for actually, the mercerized and the unmercerized do not differ very much.

Mr. Nuessle: May I interrupt? I disagree with Mr. Nickerson. In those fabrics we have studied, where there has been a difference the mercerized has been more susceptible to treatment. Of course, there is a wide difference between fabrics, as you know.

Mr. Rutherford: Do you strip the material with phosphoric acid?

Mr. Nickerson: Yes.

Mr. Rutherford: Is that a solvent for the resin, or do you feel it is acid enough?

Mr. Nickerson: It is about pH 2.0, I think, at room temperature.

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Correction

IN the paper "Recent Results of Textile Research Institute and Textile Foundation Research" by J. H. Dillon which appeared in the December 26, 1949 issue, the caption for figure 3 on page P940 was incorrectly printed. The correct caption follows:

Fig. 3
Eyring Three-Element Model
F = total stress on the fiber
f = stress on Maxwell element
$l = l_1 + l'$ = elongation of fiber

$\dot{l}$ = rate of elongation
α and K = Eyring viscous constants

$\beta = \dot{l}/K$ when $\dot{l}$ is constant
k_1 and k_2 = spring constants

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Martin to Speak at WNE Meeting

PAUL J. MARTIN of the Textile Development Laboratory of Socony-Vacuum Laboratories, Brooklyn, N. Y., will be the speaker at the January 27th meeting of the Western New England Section at Rapp's Restaurant in Shelton, Connecticut.

Mr. Martin will speak on "Problems In The Development of Efficient Woolen Fiber Lubricants". Results of a comprehensive wool oil evaluation program at the Lowell Textile Institute will be shown.

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Analytical Methods for a Textile Laboratory

THE first printing of "Analytical Methods for a Textile Laboratory" has been quickly sold, and for the present, no more copies are available. More will be printed and advertised in the Reporter. Orders now in the hands of the Secretary will be given first attention.

Rhode Island Section—

SILICONES IN THE TEXTILE INDUSTRY*

F. L. DENNETT

Dow Corning Corporation

SILICONES in a wide variety of forms have been developed since the commercial availability of these semi-inorganic materials was first announced in 1944. Silicones are now available in the form of fluids, mold lubricants, greases, dielectric sealing compounds, antifoaming agents, electrical insulating varnishes and resins, resins for formulating protective coatings and rubber-like materials. Because of their exceptional stability over a wide temperature range, their dielectric properties and their water repellency, these various silicon products have proved their usefulness to production men and plant engineers in every major industry including the spinning, weaving and finishing of textiles.

All of the silicones have a high degree of water repellency which is probably due to the peculiar orientation of the hydrocarbon groups which are bonded to the silicon atoms. It is this property that is of special interest to the textile industry. The degree of water repellency varies somewhat with the composition of the various silicones. In most cases the application of heat alters the orientation of the hydrocarbon radicals, resulting in an increase in water repellency.

Applications

The first application for silicones involving this specific property of water repellency was in the treatment of glass and ceramic insulator bodies. In this application the insulators are dipped in a solvent solution of a silicone fluid and cured for 30 minutes at 300°C. This silicone surface is extremely water repellent and is not easily removed by solvents or detergents.

The next application was the hydrophobing of glass fabrics with which some of you may be familiar. A silicone fluid emulsion is padded onto the glass fabric and water repellency is developed by curing at high temperatures for a short time.

These silicone materials showed such promise as a water repellent treatment for glass fabrics that a program was set up to develop a similar water repellent for organic fabrics. This necessitated the preparation of a silicone in which water repellency could be fully developed by curing at temperatures tolerable to organic fabrics. After much research and testing, a silicone designated as DC 1107 was obtained. This material has the general characteristics of other silicone fluids, but it is much more reactive. Its hydrophobing properties are fully developed by curing for a short time at temperatures applicable to all fabrics. Further testing showed that DC 1107 was most applicable to nylon and acetate rayon, but that it was difficult to apply without excessive mark-off and some stiffening. Continued research resulted in the introduction some six months ago of an improved material known as DeCetex 104 for treating nylon and acetate rayon.

DeCetex 104 is a viscous, high polymeric silicone supplied as 65% solids in a non-toxic and non-inflammable solvent. This silicone is colorless, odorless, and contains no corrosive chemicals. DeCetex 104 is easily applied to fabrics from a dilute oil-in-water emulsion with conventional equipment such as a pad or quetsch. The fabric is then dried at any convenient temperature followed by a short cure at a higher temperature. DeCetex 104 imparts to each filament a tightly bonded, water repellent silicone surface after curing that is durable to soaps and dry cleaning solvents.

DeCetex 104 was designed as a durable water repellent treatment for nylon and mixtures containing a large percentage of this fiber. Nylon fabrics ranging from a loosely woven marquisette to a tightly woven 8 oz. material have been treated successfully with DeCetex 104. Fabrics containing acetate rayon and mixtures of acetate and viscose also can be easily and successfully treated with this material. Laboratory tests and mill trials have also established the effectiveness of DeCetex 104 on 'Orlon'. Modifications of DeCetex 104 as a water repellent treatment for cotton, or mixtures of cotton and other fibers, are under development but are not at present ready for production runs.

DeCetex 104 may be applied to the fabric from an oil-in-water emulsion or from a solution prepared with hydrocarbon or chlorinated solvents. A dilute emulsion or solution of DeCetex 104 is applied to the fabric with pad or quetsch to give a 2 to 3% silicone pickup. The amount of DeCetex 104 necessary to give satisfactory results will depend somewhat on the type of weave, the weight of the fabric and the fiber compositions. Highly water repellent silicone finishes which show exceptional durability have been obtained on acetate rayon with 0.5% DeCetex 104 pickup. On some nylons a pickup of 1.5% based on the original weight of the fabric is very satisfactory. After padding, the fabric may be dried at any available temperature and cured by heating for 3 to 5 minutes at 300°F. Higher curing temperatures may be used with correspondingly short curing times if the physical haracteristics of the fiber allow use of elevated temperatures. This type of curing is used in finishing nylon where a temperature above 400°F. is applied for 10 to 30 seconds to set the fibers. The absence of harmful materials in these silicone emulsions or solutions eliminates need for giving the fabric a final rinse after curing.

* Presented before the Rhode Island Section, October 28, 1949.

Data obtained from laboratory applications and mill trials show that a properly applied silicone water repellent finish has exceptional durability to laundering and dry cleaning. Nylon fabrics have given spray ratings of 80 to 90 after two launderings, each consisting of a two hour operation at 160° F. according to the "Resistance to laundering and wet mechanical action" test described in the supplement to Federal Specification CCC-T-191a. After five dry cleanings, each consisting of one hour in a tumble jar with Stoddard solvent, spray ratings of 80 to 90 are obtainable. Dynamic absorption values on treated nylon after a 20 minute period are one-third of the untreated values. The air permeability of a DeCetex 104 treated fabric is usually increased to some extent. Impact penetration or drop penetration values are high regardless of the porosity of the treated fabrics.

Equally good durability is obtained with acetate rayon fabrics. After three 40 minute rayon washes, spray ratings are in the order of 90 to 100. After three dry cleanings, a spray rating of 100 is usually retained.

Based on their own experience, textile finishers report that DeCetex 104 has these desirable properties:

1. The DeCetex 104 emulsion wets out the fabric readily even on difficult-to-wet materials.
2. No toxic fumes or odors are evolved during treating and curing of the fabric.
3. No neutralizing or washing is required after curing the fabric.
4. A fabric treated with DeCetex 104 is not subject to mark-off and it has a soft, smooth and full hand.
5. The cost of the silicone finish applied to the fabric is comparable to other types of durable repellent finishes.

On some losely woven fabrics a noticeable slip is added to the yarns. If this is harmful, the condition may be remedied by adding a small amount of a good anti-slip agent to the silicone emulsion.

In treating fabrics with DeCetex 104 it is necessary to have the fabrics thoroughly clean and free of all previous finishing materials and wetting agents.

Other Silicone Products Useful in the Textile Industry

A number of other silicone products can be used to great advantage in the textile industry. For example, one of the most valuable silicones to the textile processor is a silicone defoamer. DC Antifoam A is a colorless, translucent material having a honey-like consistency. It is insoluble in aqueous systems but may be dispersed in solvents such as cyclohexane, pine oil, Stoddard solvent, or tetrachloroethylene for use in both aqueous and non-aqueous systems. This material is also supplied as an emulsion for use where a solvent dispersion is impractical. This silicone defoamer is generally effective in concentrations ranging from 20 to 200 parts per million. Calculated on the basis of the quantity required to produce satisfactory results, this silicone antifoam is generally the least expensive material to use, even though its cost per pound is considerably higher than that of ordinary defoamers.

In all textile plants, lubrication is a serious problem because of moisture and high temperatures. The high temperature stability of greases is of more than ordinary importance because of the danger of damaging fabrics if grease bleeds out of a bearing. Silicone oils having exceptionally flat viscosity — temperature slopes have been compounded into greases which have high heat stability, low volatility, and relatively slight changes in consistency over a wide temperature range. These silicone greases have many times the life of petroleum greases in high speed ball bearings at 300 to 350°F. One silicone grease has been reported to give 45 times the life of an organic grease in the ball bearings of drying cans operating at 400 R.P.M. Slasher bearings and tenter frames are also most effectively lubricated by silicone greases. Silicone greases are also useful in dry boxes, low speed oven machinery and pumps handling hot liquids.

In most textile mills electric motors are subject to moisture, high temperatures, lint and dust. Under these conditions, silicone (Class H) insulation will increase the life of motors as much as 10 times. This type of insulation permits motors to operate safely at temperatures 200°F. above normal limits. It gives greater reliability and results in lower maintenance costs. The value of silicone insulation in electric motors is demonstrated by the 30,000 spinning bucket motors in rayon mills which have been rewound with silicone (Class H) insulation during the past two and a half years. These motors are exposed to acids and subjected to high starting loads. The life of Class A insulated motors ranged from a few weeks to a few months. Silicone insulated motors have been in continuous service for over two years.

Silicones are very versatile materials. They have been compounded to give high temperature greases, oils, antifoaming agents and electrical insulating materials which are of untold value to the textile processor. They have been made into a durable water repellent finish for nylon and acetate rayon. New developments in the field of silicone chemistry promise to provide the textile industry with other materials of equal or even greater usefulness.

(See also Am. Dyestuff Reporter, 36, P748 (1947) by same author.)

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Philadelphia Committee Chairmen

AT a recent meeting of the 1950 officers and councilors of the Philadelphia Section, the following were appointed as committee chairmen:—

Membership—C. T. Anderson—Ciba Co., Inc. *Program*—Harry L. Morgan, James Lees & Sons. *Publicity*—Thomas J. Scanlon, Calco Chem. Div. *Annual Outing*—Richard L. Jones, Royce Chem. Co. *Intersectional Contest*—Harry F. Clapham, Du Pont Co. *Judge, Intersectional Contest*—Jackson A. Woodruff, American Viscose Co. *Dining*—Frederick V. Traut, Globe Dye Wks. *Bylaws*—Prof. P. Theel, Phila. Textile Inst. *Delegation to Annual Convention*—William O. Neeb, Althouse Chem. Co. *Auditing*—S. Graham Turnbull, Jr.,DuPont Co. *Sectional Research Committee to 1952*—Dr. Malcolm J. Reider, Geo. W. Bollman & Co., Felice DeMaria, James Lees & Sons and Dr. Raymond B. Seymour, Atlas Mineral Products. *Administration of Special P.T.I. Fund*—Walter F. Fancourt, 3rd, W. F. Fancourt & Co. *Nominating*—Walter F. Fancourt, 3rd.

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Report of Bradford Durfee Technical Institute Student Chapter

A JOINT lecture meeting of the A.A.T.C.C. and American Chemical Society Student Chapters of B.D.T.I. was held Thursday evening, Dec. 15, 1949 at the Institute's auditorium. The guest speaker of the evening was H. L. Ebert, Chief Chemist at Firestone, Fall River Division. The topic of his lecture was "Rubber in the Industry".

The lecture was of interest to both the chemist and dyer, for it dealt with the manufacturing and dyeing of rubber.

Respectfully submitted,

RICHARD PAUL BARBER, *Secretary*

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Dues and Membership Cards

PERSONAL dues payments for the current year have been acknowledged with membership cards, and further payments will be acknowledged promptly as received. If you fail to receive such acknowledgment, please notify the Secretary, A.A.T.C.C., Box 28, Lowell, Mass.

ABSTRACTS

Vat Acids in the Dyeing Technique

Melliand Textilberichte, August 1949, p. 364-368, Dr. Joachim Müller

The author reviews the development of former methods used in the field of dyeing with vat acids. Initial studies might be retracted to the observation that the vat acids of Indanthrene Blue RSN and GCD can be maintained in colloidal dispersed state under certain conditions. The basic advantage can be seen in that the vat acids by themselves have no affinity to the fiber while they are readily transformed on the other hand into true vats in the presence of alkalis. Applications in dyeing on apparatus, padding on the mangle or jig or in continuous processes, and optionally using the "Electrofixer" (G.P. 651,607, see also *Mell.* 1937, 308) have been studied and the whole problem of using vat dyes in practice has quite generally been solved that is, the first difficulties have principally been overcome. Former methods in the vat acid technique (i.e., in dyeing with partly neutralized vats) consisted of diluting the alkaline vats to attain a more or less complete dissociation which proved to give irregular results; moreover, the vats present in the enol-state were partly transformed into the keto-form which is useless in dyeing. Consequently, complete neutralization of the vats was tried to obtain the leuco compounds in a very fine suspension in colloidal state. The absolute lack of affinity of these compounds made a quite uniform impregnation possible followed by immediate transformation into the vat proper in the subsequent alkaline treatment. In dyeing bobbins on apparatus, the alkaline aftertreatment has to be carried out very carefully in contrast to piece impregnating operations because the fibrous material adsorbs a relatively small portion of the liquid while the major part remains in the bath. The gradual addition of alkali-hydrosulfite is necessary here. The author found further that under certain conditions most of the vat dyes available in the trade can be applied in pad-dyeing with vat acids; some few exceptions are indicated. Setamol WS, a condensate of β-naphthalene sulfonic acid and formaldehyde, proved to be a very useful assistant. Details for effecting the continuous methods are offered. The effects of the final development of the vat in the "Electrofixer" are compared with those obtained by the Du Pont pad-steam method and the development in the Williams unit. The author prefers the "Electrofixer" which enables fixing the vat at high speed, at high temperature, and in concentrations far superior to the two other methods which call for operating in reducing liquids, partially in steam atmosphere.—P.W.

Adsorption of Soda Lye and Basic Dyes by Wool, Silk and Polyamide Fibers

Melliand Textilberichte, Sept. 1949, 405, Dr. E. Elod and Dr. H. G. Frohlich

It has not been known up to now that wool and natural silk behave equally as far as the absorption of sodium hydroxide is concerned. It could be proven that in both cases the absorption starts at a pH value of 7.0, increasing slowly at first, sharply rising between 11.5-13.5 and then attaining the saturation point. This absorption is apparently caused by reactions with the corboxy groups, with phenol-hydroxy groups of tyrosine, and by addition of NaOH to the CO radicle of the peptide groups. The materials investigated were scoured wool, natural silk pretreated with Marseille soap and polyamide fibers cleaned the same way as wool. The reaction with soda lye proceeds on wool and silk so fast that it is necessary to work with cooled lye to retard the process and to permit thorough investigation. Polyamide fibers require longer reaction periods and the experiments were carried out at 20°C. The alkali absorption was determined by titration with N/10 and N/100 Hcl respectively. It was found that the alkali absorption of polyamide fibers was analogous to that of wool and silk. The second part of the article deals with the problem of absorption of basic dyes (Methylene-Blue B, Rhodamine B, and Crystal Violet). It could be proven that the absorption of this type of dyes increases with the alkalinity of the solution, attaining a maximum value at the same pH for all fibers investigated. The quantitative dye absorption of polyamides, however, is decidedly less than that of wool or silk.—P.W.

Reducing Properties of Standard Vegetable Thickening Agents

"Textil Praxis" 1949, 9, p. 460, Dr. R. Haller

The author found, according to *Helv. Chim. Acta* XXIX, 1157, a testing method for determining the reducing properties of certain modified starch thickeners by adding some Cibanone Yellow GN in paste to the slightly alkaline suspension and warming for 15 min. on the steam bath to 65-70°C. The paste appeared either yellow or slightly green (or even dark blue) according to the reducing activity of the sample. In the latter event a strong reducing power has to be assumed. This same qualitative test was applied to the thickening agents in Table I.

This reaction gives sufficient first hand information regarding the reductive properties of the normally used printing thickeners. It will probably be valuable for predicting the behavior of various printing pastes in practice.—P.W.

TABLE I

Material	*Reduction*
Gum Cordofan 1:1 water	Blue, changed to the original yellow shade after continued shaking only.
Gum Tragacanth 6%	Only slightly green.
Wheat Starch in suspension	Slight bluish olive.
Corn Starch 6% thickener	Yellowish olive.
Potato Starch 8% thickener	Very slight greenish shade.
Locust Gum 2%	Slightly green after longer standing only.
British Gum 1:2	Green color, shifting after some time over blue-olive to blue.
Renose (Ciba) (Alkyl cellulose)	No color reaction.
Keltex (Alginate, U. S. provenience)	Almost no change.
Alginate (French sample)	Quick change to green, shifting after 15 min. to bluish olive.

TRADE NOTES • NEW PRODUCTS

Macbeth's Newburgh Plant

• Macbeth Plant Removal

The Macbeth Corporation announces the occupancy of its new plant at Newburgh, New York, since Jan. 2. All the manufacturing activities of the Macbeth Corporation, together with its executive and general offices, are now located at Newburgh, which is situated on the west bank of the Hudson River, about sixty miles north of New York City and served by railroad and highway.

Greatly increased area available in the plant permits an expansion of Macbeth manufacturing and research facilities and allows improved service to its customers, the company states.

• U. S. Testing and Esselen Merge

The integration of the United States Testing Company, Inc., Hoboken, New Jersey, and the Esselen Research Corporation, Boston, Massachusetts, has been announced by Allen L. Brassell and Dr. Gustavus J. Esselen, presidents of the two organizations. On January 1, 1950, the Esselen Research Corporation became the Esselen Research Division of the United States Testing Company, Inc., and is now continuing its operations in Boston under the direction of Dr. Esselen, its founder, who was recently elected to a vice-presidency in the U. S. Testing Company.

The Esselen Research Corporation was founded by Dr. Esselen, whose independent consulting practice dates back to 1921. Dr. Esselen is prominent as an authority on cellulose chemistry and is chairman of the American Section of the Society of Chemical Industry of Great Britain. For two terms he served as director of the American Chemical Society and also of the American Institute of Chemical Engineers. He is a fellow of the American Academy of Arts and Sciences, and has served as a member of the Council of that organization. He is also a fellow of the American Institute of Chemists and a member of the American Institute of Consulting Engineers. He is vice-president of the American Council of Commercial Laboratories, and recently completed a term as director of the Boston Chamber of Commerce. His associates in the Esselen laboratories constitute a group with experience in many fields of industrial chemistry and chemical engineering. Their services include new product development, product improvement, technical advice on patent and legal matters and economic surveys.

The staff comprises men with special background and experience in cellulose chemistry, colloids, cosmetics, dyestuffs, electronics, emulsions, flavors and perfumes, food technology, leather, mildew and fungus prevention, organic chemistry, paper and pulp, photography, plastics and resins, natural and synthetic textiles, tobacco, waste disposal and utilization, wood products and wood pulp. Reported among the outstanding accomplishments of the Esselen organization are the discovery and initial development of melamine resins, the development of two basic processes for the continuous production of sheet plastics, and the development of the first process for producing high tenacity viscose rayon.

The United States Testing Company, Inc., was founded in 1880. With its main laboratory in Hoboken and with branch laboratories in principal cities throughout the country, the Testing Company undertakes several thousand projects of varied nature annually. Among the fields which it serves are textiles, metals, ores, plastics, leather, minerals, fuels, chemicals, drugs, foodstuffs, soaps and detergents, fats and oils, waxes and cosmetics. In addition, it operates an engineering laboratory which offers a research and testing service in such fields as acoustics, electricity. electronics, optics, ultra-sonics, x-ray, air conditioning, filtering, refrigeration, heating, ventilating and industrial machines. Its bacteriological and biological departments are highly regarded, and it has recently installed a special laboratory for the utilization of radioactive isotopes in industrial research.

Dr. George Zinzalian

• E. F. Drew Appointment

E. F. Drew & Co., Inc., has announced the appointment of Dr. George Zinzalian as Sales Manager of the Technical Products Division.

Dr. Zinzalian has been connected with the Drew organization for over 16 years, serving in important capacities including supervision of production, product development and research at the Boonton, New Jersey, plant.

Dr. Zinzalian will direct the sales and service activities of the Technical Products Division and Textile and Leather Oils Departments. He will be responsible for the sale of all products produced by these departments including Fatty Acids, Textile Detergents, Sulphanated Oils, Synthetic Esters, Cationic Softeners, Yarn Processing Chemicals and Leather Oils. His location will be at the general ffices of the Drew Company at 15 East 26th Street, New York 10, N. Y.

• Hunter Purchases Leyland

James Hunter Machine Company, North Adams, Massachusetts, manufacturers of woolen and worsted preparation and wet finishing equipment for over 100 years, announces the purchase of Thomas Leyland Machinery Co., Inc., Readville, Massachusetts, manufacturers of fabric expanders and cloth opening equipment. Hunter will continue operation of the Leyland plant in Readville, producing the line of Mycock cloth expanders, scutchers, and aluminum and plastic suction bobbins.

Both the 3-bar and 5-bar Leyland-Mycock expanders, which reportedly can be regulated in a few seconds to give varied widths of expansion while the machine is in motion, have demonstrated advantages to manufacturers of cotton, woolen, rayon, silk and rubberized materials.

Leyland-Mycocks are said to have more positive action. The bars are rotated by the slightest pressure, yet act on both sides of the cloth, it is stated.

The Leyland-Mycock can be used with singeing machines, water mangles, starch machines, dry cans, calenders, tommy dodds, mercerizers, dye padders, soapers, washers, tenter frames, winders, carbonizers or with any type of textile machinery requiring its services, it is stated.

Hunter states that with the addition of the Leyland line, it now has one of the most modern and complete lines of textile preparation and wet finishing equipment, plus a nationwide service organization familiar with every aspect of textile processing.

The new name of this recent amalgamation will be Thomas Leyland Machinery Division of James Hunter Machine Company.

• Currier New LTI-NY Alumni Head

Arthur M. Currier, Latta-Currier Co., New York, was unanimously elected to the presidency of the New York Chapter of the Lowell Textile Institute Alumni Association for the forthcoming year in a meeting of the Chapter at Hans Jaegers's Restaurant, New York, on December 8th.

Irwin Smoler of Smoler Bros., New York, was also unanimously elected to the post of Secretary-Treasurer.

Guest speakers at the meeting included Martin J. Lydon, dean of students at LTI, A. Edwin Wells, head of the Alumni Association, William F. Brosnan, President-Nominee of the Alumni Association, and John R. Robertson, a professor in the Social Sciences Department at Lowell.

Following dinner, Mr. Currier named several committees to assist him in carrying on alumni affairs in the New York area. He also announced the distribution of a business roster covering those in the metropolitan area.

• Stainless Steel Scoops

A new group of stainless steel, round-bottom scoops has been added to its line of corrosion-resistant utensils by Metalsmiths division of Orange Roller Bearing Co., Inc., 560 White St., Orange, N. J. The scoops are reported to be made entirely of type 304 Stainless Steel, to have smooth, homogeneous butt welds by the heliarc process, and to use no filler rod or flux. All corners are rounded and tubular handles are closed, it is stated. The entire construction is said to be designed to eliminate crevices, seams, joints or rough spots which might catch and hold the materials handled, and also to facilitate cleansing or sterilizing. Available in ½ pt., 1 pt., 1 qt., 2 qt., and 4 qt. sizes for shipment.

Alan A. Claflin

Kenneth L. Dorman

• Hilton-Davis Names N.E. Representative

Hilton-Davis Chemical Company Division of Sterling Drug Inc., has named the newly formed Claflin-Dorman Company, Boston, its New England sales representative for textile dyes and allied products for the textile, paper and leather industries.

Nelson S. Knaggs, vice-president in charge of sales, announced that the appointment became effective Jan. 1, marking further expansion of the division's sales efforts inaugurated last year with the appointment of the Blackman-Uhler Company, Spartanburg, S. C., as southern textile sales representatives.

The Claflin-Dorman Company has established headquarters at India Square and Storer Street, Boston. The five-story building at this address is reportedly being renovated to provide office, laboratory and storage facilities for the Hilton-Davis line of dyestuffs and allied products which will be distributed from this center to New England consumers.

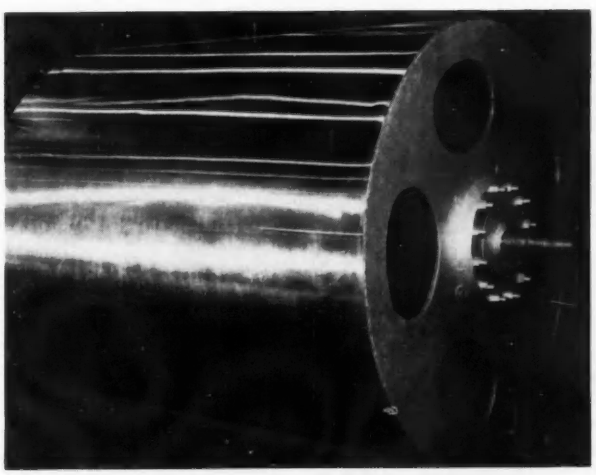
The company was formed for this purpose by Alan A. Claflin, who formerly maintained his own office at 88 Broad Street, Boston, and Kenneth L. Dorman, most recently vice-president in charge of manufacturing of the Lott Chemical Company, Paterson, N. J. Mr. Dorman's paper, "The Chemical Constitution of the Naphthol AS Type Dyes", is one of a number of scientific publications for which he has been responsible. Mr. Claflin has been for many years a New England distributor of dyestuffs. Both men are graduates of the Massachusetts Institute of Technology and Dr. Dorman also attended the Lowell Textile School.

Hilton-Davis now makes nearly 100 different dyestuffs, under the classifications of naphthols, special acids, basic dyes, fast bases and salts, it is stated. Two products recently added to the line are naphthol ITR and ITR bases.

The division is a corporate member of the American Association of Textile Chemists and Colorists. Both Mr. Claflin and Mr. Dorman hold individual memberships.

• 5-Foot Diameter Drying Cylinder

S. Blickman, Inc., Weehawken, N. J. has announced their stainless steel drying cylinder 60" in diameter, used for high speed drying of textiles.



Blickman 5' Diameter Drying Cylinder

The stainless steel outer surface is highly polished and is welded to the end plates, the company states. An inner shell, concentric with the outer polished stainless surface, is also welded to the end plates forming a steam chamber for keeping the cylinder hot, it is reported.

The manufacturer also produces other drying cylinders in a variety of sizes, including high pressure steam cylinders which they state are built to A.S.M.E. code specifications.

• New Starch Discovery

National Starch Products, 270 Madison Ave., New York 16, N. Y. has come up with a new starch discovery called Dry-Flo, a powder derivative of ungelatinized granule corn starch. Each granule is reportedly anchored to a water-repelling film of hydrocarbon radicals.

The powder is said to flow like a liquid through a separatory funnel. It has a soft, silky texture and its extreme fluidity or mobility permits it to be pumped or sprayed like a liquid or to be easily dispersed to an unusually fine and penetrating dust, the company states. Dry-Flo is not wetted by water, it is claimed, and cannot be gelatinized by heating in water, though this can be modified by first moistening with alcohol or another water miscible solvent. The product, which floats, is said to give viscous stable pastes from which films with decided water-repellent properties can be obtained.

Dry-Flo is reported easily suspended in organic solvents, oils, lacquers, etc. and is hydrophobic. National states that it does not clump due to the absorption of moisture. It is suspended in the solvent and even though it settles to the surface of the water, it continues to be easily resuspended in the solvent, it is claimed.

• Calco Research Men Promoted

R. H. Kienle, Director of Application Research, American Cyanamid Company, Calco Chemical Division, Bound Brook, New Jersey, has announced that H. E. Millson has been appointed an Assistant Director of the Application Research Department in charge of the Dyes Technical Evaluation Section; Dr. T. F. Cooke has been appointed an Assistant Director of the Application Research Department in charge of the newly created Products Application Section for the study and formulation of dyes, finishes, and pigments for new uses and the investigation of new and better application methods; and R. J. G. Schofield has been appointed a Section Director in charge of the Textile Dyeing and Printing Group of the Dyes Technical Evaluation Section.

H. E. Millson

H. E. Millson is prominent in the subjects of wool dyeing, fluorescence, phosphorescence, the presence of metals in dyeing and the behavior of dyes on wool. He is a member of the American Association of Textile Chemists and Colorists, American Association of Textile Technologists and the American Chemical Society.

T. F. Cooke

T. F. Cooke, a native of Pittsfield, Massachusetts, received his B.S. degree in chemistry from the University of Massachusetts in 1934 and Ph.D. degree in physical chemistry from Yale University in 1937. He was employed by the Standard Oil Development Company as a research chemist, from 1937 until 1940 when he came to Calco. Following his return to Calco from war service, Dr. Cooke was appointed an Assistant Director of Physical Chemical Research and served in that capacity until his present appointment.

R. J. G. Schofield

R. J. G. Schofield was born in Winnipeg, Manitoba, Canada, and obtained his Bachelor of Engineering (Chemical Engineering) from McGill University in 1935. Prior to joining Calco in 1946, Mr. Schofield was for several years with Canadian chemical and textile companies.

• General Dyestuff Releases

General Dyestuff Corporation, 435 Hudson St., New York 14, N. Y. has announced the release of two new circulars.

Circular G-621 deals with Algosol Blue 06B-CF—"the water-soluble leuco ester of the greenest brominated indigo, that indigo which possesses the distinction of turning even greener in artificial light." It is stated that this dyestuff is applicable to cotton, wool and other fibers by either printing or dyeing methods whereby the vat dyestuff from which the leuco ester has been derived is regenerated inside the fiber. The circular goes on to deal with use of the dyestuff on cotton and similar fibers, wool and wool unions, application, printing recipes, in the jig, on the continuous range, and fastness properties.

Circular G-631 introduces Algosol Brilliant Violet 14R-CF—"the water-soluble leuco ester of Indanthrene Brilliant Violet 4RA, a well-established vat dyestuff of the anthraquinone series with excellent fastness properties." The product is said to be important for the coloring of cellulosic textiles because of the ease with which it can be printed or dyed to obtain Indanthrene fastness. It is stated that the attainment of excellent fastness properties on wool and silk by comparatively simple and short dyeing methods without the use of strongly alkaline solutions also makes this dyestuff of great interest for animal fibers where the maintenance of hand and quality is so important.

This circular goes into detail on application, printing of wool and silk, dyeing wool, dyeing cotton and rayon, jig dyeing, continuous range and properties in regard to Algosol Brilliant Violet 14R-CF.

• Booklet on Vinylite Resins and Plastics

Bakelite Corporation, 300 Madison Ave., New York 17, N. Y. has issued a revised edition of "Vinylite Resins and Plastics", available to all. The booklet is attractively illustrated and contains material on the following: resin types, a partial listing of uses, flexible, cast and laminating films, flexible sheetings, coated paper, rigid sheets, monofilaments, molding and extrusion compounds, floor covering, plastisols, cloth and surface coatings, adhesives, wire and cable insulation, safety glass interlayer, bakelite polyethylene and tables of properties.

• Synthrez C

Synthron, Inc., Ashton, R. I. announces large scale production of Synthrez C, a highly polymerized, water soluble, modified urea-formaldehyde resin. Synthrez C is a clear, colorless syrup, said to be readily soluble in water and stable for several months storage under favorable conditions.

Specifications are as follows:
Total Active: 65%.
pH: 7.7 ± .3.
Viscosity @25°C: 2.5-3.5 poises.
Specific Gravity @25°C: 1.2.
Weight per gallon: 10 lbs.
Cured resin yield: 50%.

Synthrez C is said to be widely used in the production of durable finishes to enhance the body or fullness of rayon, cotton and nylon fabrics and wool-rayon blends. Any degree of crispness or fullness reportedly can be obtained by the proper formulation. It is also used for ribbon finishes and slip-proofing effects. Owing to its high degree of polymerization, a minimum amount of resin is required when Synthrez C is employed, the company states.

Synthrez C is employed in conjunction with the nonemeric methylolurea, Synthrez D, to increase fullness in crush-resistant or shrink-resistant finishes, and in glazed chintz or durable mechanical effects.

Bulletins and samples are available.

• ASA Elects

The American Standards Association announced election of three new members of its Board of Directors as of January 1, 1950, for a term of three years. Maurice Stanley, Chairman of the Board of the Fafnir Bearing Company, represents the Anti-Friction Bearing Manufacturers Association, Inc.; B. S. Voorhees, vice-president of the New York Central System, represents the Association of American Railroads; and Colonel J. G. Vincent, vice-president, Packard Motor Car Company, represents the Automobile Manufacturers Association.

In addition, E. E. Potter, vice-president of the General Electric Company, has been named by the National Electrical Manufacturers Assocaition to fill out the unexpired term of Clarence L. Collens, who has retired as chairman of the Reliance Electric and Engineering Company. Miss Ardenia Chapman, Dean of the College of Home Economics, Drexel Institute of Technology, Philadelphia, is completing the unexpired term of Mrs. Carol Willis Moffett, American Home Economics Association as member-at-large.

Continuing on the Board for another three-year term are J. H. McElhinney, vice-president of the Wheeling Steel Corporation, representing the American Iron and Steel Institute, and Auguste G. Pratt, Chairman of the Board of Babcock & Wilcox Company, representing the American Society of Mechanical Engineers. R. Oakley Kennedy, formerly vice-president of Cluett, Peabody and Company, Incorporated, has been re-elected member-at-large for the next three years.

• New Fiber Softener

Zimmerman Associates, Chemists & Enlina, announce the installation of additional stainless steel equipment for the increased production of Zavel, their new cation active softener for textile fibers. It is reported that in the past, this softener has been produced entirely in the pilot plant with a rated capacity of 21,000 pounds per month. The new equipment reportedly has a rated capacity of 468,000 pounds per month.

Zavel is unique in that it is an excellent permanent softener for all fibers and also in that it will not yellow whites, even at extremely high temperatures, the company states. It is further stated that it may be used in conjunction with all types of resins and has the property of reducing tendering of the fabric during the curing process. Zavel is said to increase lightfastness of dyestuffs, including vat colors. White consumer goods which have been treated with Zaval and stored for a period of more than a year are reported to have shown no yellowing or odor formation.

• Michigan Alkali Shifts

Bert Cremers, Vice-President, Michigan Alkali Division of Wyandotte Chemicals, announces the following promotions and reassignment of duties of the home and New York Office staffs, as of January 1:

Howard F. Roderick—General Sales Manager.

Paul M. Bigley—Assistant to Mr. Roderick.

Melvin E. Clark—Manager, Chlorine and Heavy Alkali Sales.

Fritz M. Zorn—Assistant to Mr. Clark.

L. C. Reid—Manager, Organic Chemical Sales.

V. H. Vodra—Manager, Calcium Carbonate Sales.

Robert K. Rigger—Manager, Export Department.

Charles S. Johnson—Director, Technical Service.

Paul E. Burchfield—Assistant Director, Technical Service.

L. D. Dodson—Manager, Calcium Chloride and Public Business Sales.

F. R. Sproule—Assistant Manager, Calcium Chloride and Public Business Sales.

Paul Weller—Manager, Market Research.

C. J. Diehl—Manager, Advertising Department.

T. R. Boyle—Manager, Sales Records.

S. B. Scott—District Manager, New York, assumes duties formerly performed by George Dunning.

R. W. Moister—Assistant District Manager, New York.

The district offices of the Michigan Alkali Division in St. Louis, Chicago, Detroit, Cincinnati and Pittsburgh remain under the management, respectively, of P. G. Fuger, M. A. Thompson, H. C. Brunner, E. Heiser and M. J. Conway.

• AASGP Convention Jan. 25-26

The twenty-third annual convention of the Association of American Soap & Glycerine Producers is scheduled for January 25 and 26, 1950, in the Hotel Plaza, New York City.

J. C. Fauré, Chief Purchasing Agent of Unilever, an international authority on fats and oils, has come to the United States to discuss the world outlook (exclusive of the United States) on that subject. Mr. Fauré is scheduled to speak on Thursday, 10 to 11 a.m.

Charles Brannan, secretary of the Department of Agriculture, will be luncheon speaker on Thursday.

Other speakers and experts have been assigned to cover such subjects as synthetic detergents, bulk soaps, market research, industrial relations, specialty soaps and glycerine.

Another innovation includes a ladies program which will be highlighted by a fashion show Wednesday 2:30 to 3:30 p.m. under the auspices of the National Cotton Council.

Social highlights include a cocktail party Wednesday, 6 to 8 p.m., and a breakfast Thursday, 7:15 to 9:30 a.m. The annual Association reception, banquet and entertainment will be held Thursday evening beginning at 7:30 o'clock. The banquet will be marked by an address to be delivered by a nationally known personage.

The Association will conduct its annual business meeting and election of officers Wednesday afternoon. Charles Luckman, president of Lever Brothers, is currently president of the Association.

Assisting J. O. Brownell, chairman of convention arrangements, and his committee aids are Roy W. Peet, secretary-manager of the Association and his assistants, J. Malcolm Miller and Frank Luther.

• Pfizer Synthetic Plant Opened at Groton

Chas. Pfizer & Co., Inc. have completed and put into commercial production a new plant for the manufacture of fine chemicals by organic synthesis at their Groton, Conn. site, supplementing synthetic organic production at the Brooklyn plant.

Although Pfizer's plant in Brooklyn has been producing fine chemicals by both fermentation and synthesis methods, the new Groton plant will better balance the company's capabilities to produce chemicals by the most expedient and economical methods, it is stated. Products reportedly being produced initially at the new Groton unit include caffeine, theophylline, acetophenetidin and other related compounds, used principally in the manufacture of Pharmaceuticals. The production of synthetic caffeine at the new plant, it is said, will augment manufacturing facilities of Pfizer's Maywood, N. J. plant, where caffeine is prepared from natural sources.

• American Aniline Releases

American Aniline Products, Inc., 50 Union Square, New York 3, N. Y., has issued releases covering three recently issued bulletins. The texts of the releases follow:

AMANTHRENE* BLUE GREEN FFB DOUBLE PASTE—A finely dispersed Vat printing paste, of excellent tinctorial value, recommended for the production of teal blues and blue greens, especially for large blotch patterns. This color is suitable for printing on both cotton and viscose. This color has the general all-around excellent fastness associated with the Amanthrene range and in addition, is highly recommended for its fastness to light, washing, chlorine, and boiling water. It is also recommended as being fast to vulcanizing. There is a considerable shade change, and an impairment to light fastness, when shades dyed or printed with this product are after-treated with Urea-Formaldehyde type finishes.—*Bulletin No. 107.*

AMANTHRENE* GREEN JF DOUBLE PASTE—A highly dispersed Vat paste recommended for both printing and dyeing of cotton and viscose. This color is the companion color to the recently announced Amanthrene Brilliant Green J Double Paste. These two colors are chemically identical, the only real difference being that the Amanthrene Green JF Double Paste is the flatter or duller of the two shades.

This color has the usual all-around fastness associated with the Amanthrene range of vat colors.—*Bulletin No. 110.*

AMACEL* YELLOW CW—A homogenous, finely dispersed dyestuff for the direct dyeing of estron (acetate rayon) and nylon. This color produces reasonably bright green shades of yellow on acetate, of good tinctorial value which makes it most suitable for the production of tans, taupes but especially for the production of heavy green shades in conjunction with colors such as Amacel Brilliant Blue B Extra. This color is commonly referred to as a "hot dyeing" color. It is highly recommended for application on the jig since it reduces selvedge shading to an absolute minimum.

The wash fastness of this color, for the fabric intended, is rated as excellent. There is practically no staining when washed against adjacent white acetate. In addition, the color is rated as having excellent fastness to light (does not break at 80 fadeometer hours), sublimation, decatizing, gas fading and, both alkali and acid perspiration. Amacel Yellow CW does not change shade when diazotized and developed and is recommended for colored discharge work only. This color leaves effect threads of viscose and/or cotton white.—*Bulletin No. 109.*

* Reg. U. S. Pat. Off.

• Hilton-Davis Making Certified Food Colors

A complete line of certified food colors is reportedly being produced by the Hilton-Davis Chemical Company Division, Sterling Drug Inc., on Langdon Farm Road, bringing a new industry to Cincinnati.

Seventeen primary food colors and an unlimited number of blends as required by the food industry, all certified for human consumption by the Food and Drug Administration, will be marketed under the brand name of "Parakeet," through the nation-wide organization of Sterwin Chemicals Inc., a Sterling subsidiary. Announcement of the new brand was made in New York by P. Val Kolb, Sterwin's president.

Large scale production by Hilton-Davis is not contemplated before early in 1950, according to James F. Thompson, vice-president of Sterling Drug, and general manager of the Cincinnati division. By then work will be completed on renovating the building on the factory site that formerly housed the division's new abandoned ink manufacturing department. Ink making equipment has all been sold. New equipment is being installed.

• Paterson Field Office Set Up

Howard J. Fletcher, executive vice-president of the Silk and Rayon Printers and Dyers Association of America, announced the opening of a field office last month in Paterson, N. J. Association headquarters remain at 1450 Broadway.

Joseph Seyer, Sr. headed a committee which reported that five out of six unions involved in the present labor contract were located in New Jersey. On the basis of the report, the decision to locate in Paterson was reached by the board of directors.

Joseph F. Wildebush, the association's director of industrial research, heads the office—located at 7 Church St. Dean M. Lewis president of the association, heads a board which determines policies and programs of the office.

Between board meetings, a Field Office Policy Committee is in charge. It consists of Alfred Bohny, Andrew Collins, John Evans, Fred Kern and James L. Meltzer as well as Mr. Seyer and Mr. Lewis.

• New Helindon Dyestuff Line

A new line of Helindon dyestuffs has been announced by General Aniline & Film Corporation.

The Helindon dyes, the announcement stated, are especially suited for dyeing wool without decreasing fiber elasticity or strength. Yarn dyed with these dyestuffs is said to show better elongation, and Helindon dyeings of fabrics have tested 10% stronger in the filling and 25% stronger in the warp than materials dyed with chrome colors.

The Helindon dyes are claimed to have superior fastness to perspiration and washing. The full line of thirteen dyestuffs is offered through General Dyestuff Corporation, General Aniline's sales agent.

• Stein, Hall Personnel Changes

Morris S. Rosenthal, President of Stein, Hall & Company, Inc., 285 Madison Avenue, New York City, announces the resignation of Joseph A. King as manager of the Providence Branch Office.

Effective immediately, Roswell D. Armstrong, who has been manager of Stein Hall's Boston Office for a number of years, has been appointed New England manager in addition to his other duties.

Jesse A. Fraser, long a member of the Providence Office staff, has been appointed manager of the Providence Office.

* Reg. U. S. Pat. Off.

• New York Board of Trade Elections

The New York Board of Trade, Inc., at a special meeting of its Board of Directors on Wednesday, December 14th, elected officers for 1950. William T. Van Atten, (Vice President, Dun & Bradstreet) was elected President.

The following representatives from the Drug, Chemical and Allied Trades Section were elected to the offices indicated below:

Vice President: Harold M. Altshul, President, Ketchum & Co., Inc.

Assistant Tresaurer: Robert B. Magnus, Vice President, Magnus, Mabee & Reynard, Inc., re-elected.

Directors: E. T. T. Williams, President, The Lambert Co.; F. Dean Hildebrandt, Vice President, McKesson & Robbins, Inc., *newly elected.*

Directors: Fred J. Stock, Vice President, Chas. Pfizer & Co., Inc.; Carl M. Anderson, Assistant to the President, Merck & Co., Inc.; Harold M. Altshul, President, Ketchum & Co., Inc., *re-elected.*

• 10th Anniversary Bacon Laboratories

On December 1, 1949, the Frederick S. Bacon Laboratories, 192 Pleasant Street, Watertown, Massachusetts celebrated its Tenth Anniversary as consultants in chemical research and development with an open house attended by its clients and many distinguished chemists from New England's universities and industries. The laboratories, which were founded as a proprietorship in 1939 by Mr. Bacon with two chemists and a secretary, is now a partnership with Philip D. Wilkinson and a staff of sixteen, it is stated. The laboratories occupy a site of about ½ acre on the Charles River, and are said to have increased in floor space nearly ten-fold from the original 750 square feet. Laboratory facilities reportedly include a library, constant temperature rooms, an electronic tensile tester and complete equipment for research and development on adhesives, plastics, leather, rubbers, textiles, organic syntheses, dyestuffs, ceramices, paints and varnishes, organic syntheses, metal platings, and bacteriology.

• Downey Elected Director

Morton Downey has been elected a Director of General Aniline & Film Corporation at the December Meeting of the Board, according to an announcement by Jack Frye, President.

Mr. Downey, Executive Vice-President of Carbagell, Inc., a chemical concern, is also a director of Coca-Cola Bottling Company of Chicago and Cigogne, Inc., perfume manufacturers. For several years he has been associated with the operations of the Chicago Merchandise Mart as well as other enterprises of Joseph P. Kennedy, former U. S. Ambassador to Great Britain.

• Malick Heads New Corporation

Albert Malick, after fifteen years with Colloids, Inc. as chemist, technician and salesman, is now engaged in his own business manufacturing specialties for yarn and fabric processing. The new corporation is Rexo, Incorporated, with plant and offices located in Elizabeth, N. J.

• New Process for Stabilizing Guncotton

A new method of stabilizing guncotton, which reportedly saves about two-thirds of the time formerly needed for making this important explosive, has been developed by the Southern Regional Research Laboratory of the Bureau of Agricultural and Industrial Chemistry. It is said to make possible a substantial cut in the cost of smokeless powder for large-caliber guns, to permit powder factories to be smaller and thus less vulnerable to air attack in the event of war, and to facilitate moving underground if necessary.

The new procedure was devised by Richard E. Reeves and coworkers at the Bureau's New Orleans laboratory. It reportedly removes most of the sulfuric acid used in the process by washing and boiling, as in the usual method, but in one-third to one-fourth the usual time (i.e., in 20 hours instead of the customary 60 to 80 hours). All remaining traces of acid are then neutralized quickly with ammonia, a procedure which is said to make further boiling of guncotton unnecessary. This final step of the new process may be carried out either at ordinary or at elevated temperatures, it is stated.

Development of the new stabilizing method reportedly is a result of research undertaken by the laboratory during the war to find out whether staple cotton cut to short lengths could be used in smokeless powder to supplement the limited U. S. supply of cotton linters. Laboratory chemists nitrated the cut cotton fibers to see if they were suitable as guncotton (which they were) and incidentally hit upon the new method of stabilizing nitrocellulose. Their findings were immediately made available to the armed forces. The process reportedly was applied successfully in a large-scale test run by the Naval Powder Factory at Indian Head, Md., in 1944.

Smokeless powder made with nitrocellulose stabilized by the ammonia procedure is said to have passed all preliminary tests and is now undergoing long-term storage trials. Investigation of the powder's stability over long periods is essential to make certain that nitrocellulose prepared by this method will perform, when needed, exactly in accordance with previous ballistic determinations.

• Annual Meeting, SOCMA

The twenty-eighth Annual Meeting of the Synthetic Organic Chemical Manufacturers Association of the U. S. was held on Wednesday, December 7, 1949, at the Hotel Commodore, New York City, with President Elvin H. Killheffer presiding. A business meeting was held at 5:15 and was followed by a social hour.

The following officers were elected at the business meeting:

President—Sidney C. Moody, American Cyanamid Company.

1st Vice-President—Dr. Wyly M. Billing, Hercules Powder Company.

2nd Vice-President—Dr. Eric C. Kunz, Givaudan Corp., Inc.

Treasurer—Clayton S. Shoemaker, Dow Chemical Company.

Board of Governors (Class of 1952)—Roger W. Hooker, Hooker Electrochemical Co. and Victor E. Williams, Monsanto Chemical Co.

Dr. August Merz, Past President, and Dr. Elvin H. Killheffer, Retiring President, were elected honorary members of the Board of Governors.

The Annual Dinner was held at 7:00 P.M. in the East Ballroom and President Moody presented Retiring President Killheffer with the replica of a bronze plaque being prepared as a gift to him from the members of the Association. The speaker of the evening was Brigadier General Thomas B. Wilson, Chairman of the Board of U. S. Plastic Products Corp. His subject was "Chemistry—The Industry with the Biggest Tomorrow".

• Butterworth Movement Completed

The first step in the $300,000 expansion program of H. W. Butterworth & Sons Co. became effective on January 3rd when the movement of all manufacturing facilities to the Philadelphia area was completed.

The Butterworth plant at Bethayres, Pa., has been enlarged to accommodate production machinery formerly in use at Providence, R. I. The consolidation places all Butterworth foundry and machine shop facilities in close proximity. Increased production and better deliveries are expected, according to Harry W. Butterworth, Jr., president.

The Providence plant, which Butterworth acquired with the purchase of Textile Finishing Machinery Co. in 1944, has been closed. Sales and Engineering offices are being maintained in Providence at 40 Fountain Street under the direction of Wallace Taylor and Stanley Brooks.

Completion of the expansion program including the new foundry at Bethayres is scheduled for June, 1950. The foundry reportedly will add 25 per cent to the firm's foundry capacity.

• Patent Applications Available

Two hundred and forty-seven additional U. S.-government owned patent applications have been made available for foreign filing through the Office of Technical Services of the U. S. Department of Commerce.

These applications are the sixth group to be released in accordance with the President's Executive Order 9865. The order authorizes the Commerce Department to acquaint private industry with Government-owned technological processes and devices for which patent applications may be filed abroad in the name of the Government for the general benefit of American industry.

The Office of Technical Services has pointed out, however, that domestic licenses on the patent applications listed are not yet available. Sole purpose of the current lists is to furnish U. S. manufacturers with an opportunity to contribute funds toward the filing of foreign applications in the government's name. Foreign patents secured will eventually be licensed to American firms on a royalty-free non-exclusive basis, it is reported.

Titles and abstracts of the applications are available for inspection at the Office of Technical Services, Room 1325, Commerce Building, Washington, D. C. Those unable to arrange personal inspections may secure photostats of the materials at the following schedules of prices for the categories listed:

Chemicals and Allied Products	$12.80
Plastics and Plasticizers	4.40
Miscellaneous Chemicals	.20
Paints, Varnishes and Lacquers	.20
Electrical Machinery, Equipment and Supplies	.20
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Paper and Allied Products	.20
Textiles and Textile Products	1.20

Orders for photostats should be addressed to the Commissioner of Patents, Washington 25, D. C., attention: "Division E".

Firms examining abstracts of cases on which they desire more details will be informed by OTS of the manner in which such additional details may be secured.

• 18th Meeting, Processing Oils and Chemicals Ass'n

The eighteenth Annual Meeting of the Processing Oils and Chemicals Association, Inc., was held at the Hotel New Yorker, New York City, on November 17th.

The session was devoted to a discussion of raw material, credit and other current conditions and future prospects in the industry.

John M. McChesney of Leatex Chemical Company, was elected President for the coming year, J. J. Grombacher of Standard Chemicals Products, Inc., Vice-President, and H. B. Sweatt, 55 West 42nd St., New York City, Secretary-Treasurer.

• Calco Announces New Dye

A new stabilized azoic dye, Calconyl Blue G Powder, and in its solution form, Calconyl Blue G Single Solution, have been announced by American Cyanamid Company, Calco Chemical Division, Bound Brook, New Jersey.

They have been recommended by the company for cotton printing, where acid aging is available, to produce economical, clear, full navy blue shades with fairly good fastness to light and excellent fastness to washing, perspiration, dry cleaning and plissé.

These Calconyl Blues are said to be satisfactory for use in patterns along with other acid aging types of dyes, such as soluble vat dyes, or with resin-bonded pigments. Suggested uses are for printing dress goods, tablecloths and handkerchiefs. They are both reported to be very stable under normal storage conditions and Calconyl Blue G Single Solution is said not to precipitate or separate on long standing in the color shop.

• A. H. Pierce Retires

A. H. Pierce, Manager of the Boston Office of General Dyestuff Corporation has retired after being with the organization since its founding.

Warren M. Dewing succeeds Mr. Pierce, according to the GDC announcement.

• Ruddick Elected Sipp-Eastwood V.P.

Howard W. Ruddick, on December 27, 1949, was elected vice-president of the Sipp-Eastwood Corporation of Paterson, New Jersey.

Mr. Ruddick has been with the Sipp-Eastwood Corporation since 1933 in a management capacity.

OBITUARY

RUSSELL L. BROWN

PROFESSOR RUSSELL L. BROWN, Head of the Wool Department at Lowell Textile Institute, died December 13 at the Lowell General Hospital as a result of injuries sustained October 12 when the plane he was piloting crashed near Jefferson, N. H. His wife, seriously injured in the same accident, is still confined to the hospital.

Professor Brown was born in Raymond, N. H. on February 11, 1894 and attended the schools of that town.

In 1929 he was appointed assistant professor of woolen yarns at Lowell Textile Institute. In 1941 he was made full professor and head of the wool department, succeeding Professor Edgar H. Barker.

He is survived by his wife, Edna, a daughter, Barbara, and a son, Russell L. Brown, Jr. of Bradford.

FLETCHER P. THORNTON

FLETCHER P. THORNTON died suddenly at his home in Summit, N. J. on Sunday morning, December 18, 1949.

Mr. Thornton was 1st Vice President and a Director of Stowe-Woodward, Inc., having been with the organization for 29 years.

He was a pioneer in the industry, and prior to his association with Stowe-Woodward, Inc. had been connected with Boston Belting Company.

He is survived by his wife and three sons, Fletcher P. Jr., Capt. James S., and Peter Thornton.

C. L. WRIGHT

AFTER an illness of three weeks, Craig L. Wright, Vice-president of Sipp-Eastwood Corporation, Paterson, New Jersey passed away on Sunday, December 11th, at the age of 45 years.

Mr. Wright came to Sipp-Eastwood fifteen years ago, after having been for some years with the Gorham Manufacturing Company.

A graduate of Manlius Military Academy and Lehigh University, he brought an informed and alert intelligence to his important work for the Sipp-Eastwood organization and will be greatly missed by textile men with whom he has been so long in contact.

Mr. Wright was a member of the Hamilton Club and President of the Charter Club, both of Paterson. His home was in Englewood, New Jersey.

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To meet such requirements, the Calcofast* Wool Dyes are ideal, and carpet manufacturers have the following selection from which to choose: Calcofast Wool Yellow N; Yellow R; Orange RN Conc.; Pink N; Red GA; Bordeaux RB Conc.; Violet 6R; Blue 2G; Blue BN; Green BS; Brown GM; Black WA.

Dyes for carpets with the cotton or jute back and wool pile, such as Axminsters, Broadlooms, Wiltons, etc., must meet high standards of lightfastness and brightness. Some degree of fastness to water, salt water and other destructive elements is also required. For such applications, Calco recommends the following: Calcocid* Yellow XX; Yellow MCG; Fast Yellow 3G Ex. Conc.; Fast Yellow 2G Conc.; Fast Light Orange 2G; Phloxine 2G; Fast Red BL; Alizarine Blue SE; Alizarine Blue SAPG; Alizarine Blue A2G. *Trade-mark

A Word About Green Shades in Vat Dyes

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Jade Green N Double	20	25	40	60	120	150
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From the above, it is evident that Olive Green BN should be the basis of pale green shades whenever it is bright enough, and should contribute as much as possible to shades where Jade Green N is required. Combinations of Calcoloid* Yellow GCD with the above dyes show good to excellent fastness, depending on the proportion of yellow which is used. The use of other bright vat yellow dyes which show better fastness in self shades will not appreciably improve the fastness of green shades, and they may contribute unlevelness and difficult dyeing behavior to the combination. *Trade-mark

Now Available . . . Calcofast Wool Violet 6R

When the Calcofast Wool Dyes on Piece Goods shade card was distributed recently, Calcofast* Wool Violet 6R was included but a statement was made that it was not yet available. Development work is now complete and this very desirable dye is in production.

Calcofast Wool Violet 6R is a metallized dye producing a clear, red-shade violet when dyed on wool. It displays the usual good fastness properties characteristic of the line, such as fastness to light, perspiration, sea water and dry cleaning. *Trade-mark

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Two New Developments for Raw Stock and Package Dyeing

Improved dyeing methods and equipment demand constant improvement in the working properties of vat dyes, if re-dyes are to be held to a minimum and uniform results are to be assured. Calco research along these lines has recently produced two new vat dyes for pressure raw stock and yarn package dyeing of cotton. They are: Calcoloid* Blue BLFD Double Paste, and Calcoloid Golden Orange GFD Paste. Both are recommended for uniform dyeing of raw stock and packages by either the pigment or reduced method. *Trade-mark

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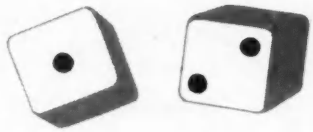

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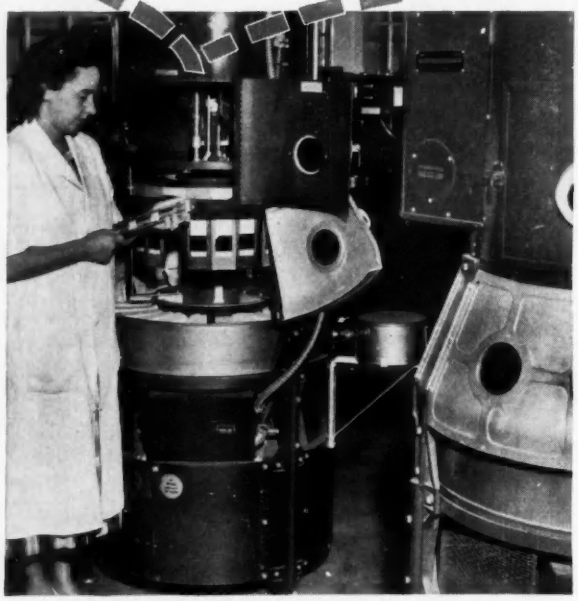

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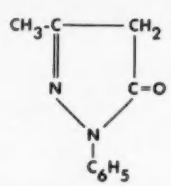

1-Phenyl,3 Methyl Pyrazolone-5
White to light tan powder
MP - 127° C
less than 1% moisture

Intermediate for the production of dyestuffs—Developer-Z

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Leading textile chemical specialty manufacturer wishes such a person as Technical Sales Representative in Georgia and Alabama. Remuneration on profit sharing basis with guaranteed salary and expenses.

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Preserve crisp detail and contrast of prints by using time-tested Culofix as an after treatment.

Kill bleeding troubles no matter where they occur—in the finishing bath—batching up after dyeing—in cross dyeing, etc.

Improve water fastness of direct colors and impart a very desirable soft, full finish at the same time, thus eliminating an extra finishing operation. (Where no softening action is needed, Culofix L should be used.)

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